

June 1989

\$5.00 £2.00

# STUDIO SOUND

AND BROADCAST ENGINEERING

ALPINE HOUSE MAGAZINE

IN THIS NUMBER:  
The Tape Recorder  
The Mixer  
The Recorder  
The Mixer  
The Recorder

**the TAPE RECORDER**



IN THIS NUMBER:  
The Tape Recorder  
The Mixer  
The Recorder  
The Mixer  
The Recorder

**the TAPE RECORDER**



MICROPHONES

STUDIO SOUND  
AND BROADCAST ENGINEERING

MIXING CONSOLES

STUDIO SOUND  
AND BROADCAST ENGINEERING

# 30

## APRS LONDON PREVIEW

For a 16 or 24 track studio owner, the future looks very good.

With MIDI systems and digital outboard, you can already achieve extremely sophisticated productions.

But it's very hard to find a recording console to match that standard, without spending a small fortune.

That's why we've developed the new Series 6000. An evolutionary design that demonstrates how far Soundcraft are thinking ahead.

Behind the classic layout is a revelation in performance and facilities.

For a start, it's equipped with enough buses and routing options to make adventurous production a pleasure, rather than a chore.

It's a full 16 or 24 bus console, plus six

auxiliary sends per channel. Each of the tape returns has EQ, which with its 'split' format naturally means they'll double as extra inputs.

We've also provided each input with push-button routing, EQ by-pass and programmable electronic muting that gives you none of the clicks ordinary switches produce.

There's even true solo-in-place, sadly lacking on many more expensive desks.

But it's the 6000's sonic performance which really puts the competition in the shade.

Take our revolutionary input design: 2dB to 70dB gain without a pad, with nearly unmeasurable distortion, cross-talk and noise.

Our new grounding system yields superb

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So nothing will change your sound, except our acclaimed, four-band sweep EQ.

In a word, purity.

And with options including 16 to 44 channels, a stereo input module and built-in patchbay, you'll find it an affordable slice of progress. No matter what budget you're working to.

The Series 6000 is simply the most comprehensive production console in its class.

Call us today for full information, and the address of your nearest dealer.



**Soundcraft**  
**6000**

# If only more expensive desks performed as well.



# STUDIO SOUND

AND BROADCAST ENGINEERING



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**SONY**

Broadcast, Recording Studio and  
Video Post Production Professionals

Sony Broadcast  
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*Dear Reader*

**Re: New analogue multi-track**

Sony are proud to announce the introduction of a new 24 track analogue audio tape recorder as a replacement for the JH-24, which over the years has become something of an industry standard.

The new machine, the APR-24, is eminently suitable for recording studios and audio/video post production. It has been designed to meet the widest range of audio recording requirements, in particular the fast and accurate synchronisation of audio with video.

Featuring comprehensive microprocessor control of both transport and audio electronics, along with versatile remote control facilities for ease of use, the APR-24 represents a major step forward in the world of cost effective analogue recording.

The APR-24 has an internal synchroniser, which being part of the machine's software, gives substantial advantages in terms of cost, space and ease of interconnection for external machine control. It also features a built-in all format timecode generator, giving versatile tape striping without the need for a separate timecode generator. In addition a multi-function metering system is included plus triggered edit synchronisation as an alternative to controlling drop-ins from an external synchroniser or studio computer.

State-of-the-art audio circuits and components ensure superb sound quality and microprocessor assisted alignment provides the user with accurate and repeatable control over machine line-up.

All these features, coupled with Sony's unrivalled reputation for quality and reliability, mean that the APR-24 is the solution to your audio problems. Don't delay - Contact your nearest Sony centre to find out more. You'll not be disappointed.

*Sincerely*  
SONY



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# STUDIO SOUND

AND BROADCAST ENGINEERING

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**EDITORIAL**

**Editor:** Keith Spencer-Allen  
**Assistant Editor:** Julian Mitchell  
**Co-ordinating Editor:** Ann Horan  
**Production Assistant:** Guy Cracknell  
**Secretary:** Elaine Sweeney  
**Consultant:** Sam Wise  
**Columnists:** Barry Fox, Martin Polon (US)  
**Regular Contributors:**

Janet Angus	David Hastilow
James Betteridge	Mike Lethby
Mike Collins	David Mellor
Ben Duncan	Terry Nelson
Dave Foister	Francis Rumsey
Neil Grant	Patrick Stapley
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**Secretary:** Dawn Boulwood

**CIRCULATION**

**Circulation and Development Manager:** Colin Enderson  
**Controlled Circulation Manager:** Sally White  
**Enquiries:** See classified advertisement

**Director:** Doug Shuard  
**Associate Publisher:** Steve Haysom

**EDITORIAL & ADVERTISING OFFICES**  
Link House, Dingwall Avenue, Croydon CR9 2TA, UK  
Tel: 01-686 2599  
Telex: 947709  
E-mail: 78:DGS1071  
IMC: STUDIOSOUND-UK/US  
Fax: 01-760 0973

**AMERICAN OFFICE**

**Publishing Services Manager:** Fred Vega  
Studio Sound, 2 Park Avenue, 18th Floor,  
New York, NY 10016, USA  
Tel: (212) 779-1212  
Fax: (212) 213-3484

**JAPAN & FAR EAST AGENT**

Contact: Mikto Tsuchiya  
Media Sales Japan Inc, Tamuracho Bldg 3 3 14,  
Shimbashi, Minato-Ku, Tokyo, Japan  
Tel: (03) 504-1925  
Telex: J25666  
Fax: (03) 595-1709

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## Happy Birthday to us!

Following our front cover, you have little excuse for not realising that we are now 30 years old. In fact, we reached that age some months ago but decided to delay any celebration until a more suitable moment—February is not really conducive to merriment.

An anniversary is just an arbitrary point in time that is dictated by a choice of units and as such really has no value in itself except as a yardstick for longevity. After 30 years we have a wealth of memories to draw upon but they reside within the pages of the magazine's history. We have no one on the staff from those early days of *The Tape Recorder* and our understanding of the magazine at that time rests solely on perusing our office library of back issues.

I first came across *The Tape Recorder* in mid 1967 when the magazine was just eight. The content was quite different from the current magazine and seemed to reflect the cottage industry nature of the recording business at that point in time. It was orientated far more towards those building their own equipment and there was a strong element of the hobbyist approach. But it was like that then!

It wasn't until 1970 that the metamorphosis into *Studio Sound* was complete. The '70s saw an explosion in the scale of the recording industry both on the facilities and the manufacturing sides. It was no longer necessary to build your own equipment—there was probably someone you could buy it from. The ever-lengthening time it took to complete recordings led to a rapid escalation in the number of studios. For example in '72 it was still possible to sit down and work out where all the multitrack tape machines in the UK were—adding up to under 40 16-track and above.

The '80s saw the trend continuing but with the addition of the return of the hobbyist element as improvements in technology put seriously spec'ed equipment into the hands of the musician and enthusiast and we saw the rise of the home studio (that grew into a major trend as well as a total misnomer). There were also other ways of making and 'recording' music that totally bypassed the traditional recording studio and everything was turned upside down.

The '90s would appear to pose the problem that when access to the equipment to make high quality music and recordings is available to anyone for fairly modest sums, the recording industry almost becomes a part of the consumer market. What is left for the professional side of the industry to call its own? The answer has to lie in knowledge and experience and a move to re-establish professionalism in our approach to recording.

As for the trade press—our role will change. It is still most likely that the form of magazines will not change dramatically—printing on paper still seems the most practical medium even at the turn-of-the-century. However, with the shelf life of products only being as long as it takes to write a new software release and the premium that will be placed on having experience and knowledge rather than just access to the equipment, the need for magazines will be reinforced but they will have to adapt to meet the new requirements and their role as a communicator during the coming decade.

So *Studio Sound* is 30. I would like to wish us a Happy Birthday and many happy returns. It's been fun!

Keith Spencer-Allen



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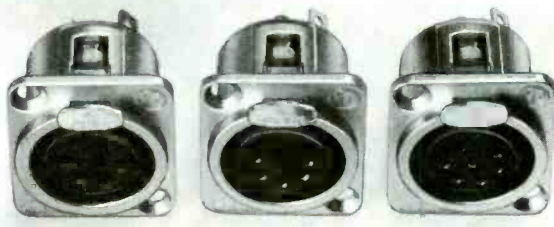
Current design NC3FX



NL8FC  
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loudspeaker socket  
large flange  
for speaker cabinets

GNS50  
gooseneck  
with twist lock



NC4FDL1

NC5FDL1

NC6FDL1



NC3FP1

NC3FP1B



NF2C/2  
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phono plugs  
nickle housing  
gold contacts



NC3FEH  
cost effective  
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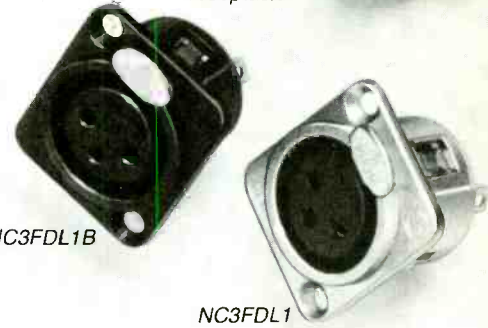
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## THE OTARI MX80

*If you're considering upgrading to Otari, we'll be delighted to arrange a full demonstration, discuss the part exchange value of your existing equipment and even arrange finance if necessary.*

*Whether you're in the market for a complete studio package, or just the latest in signal processing — we'd like to talk to you.*



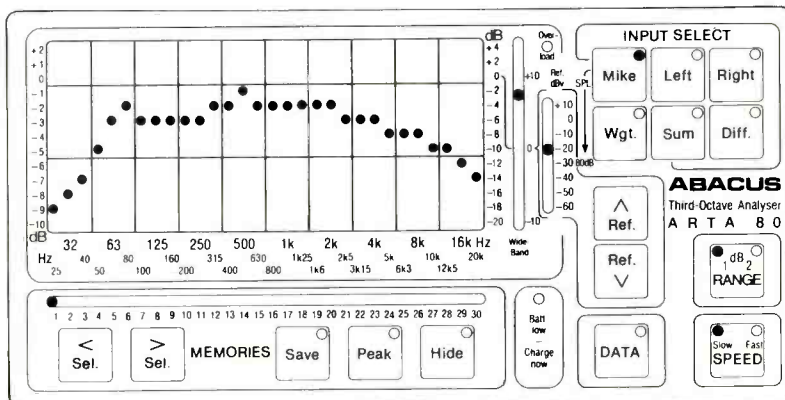
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# At the top of the charts

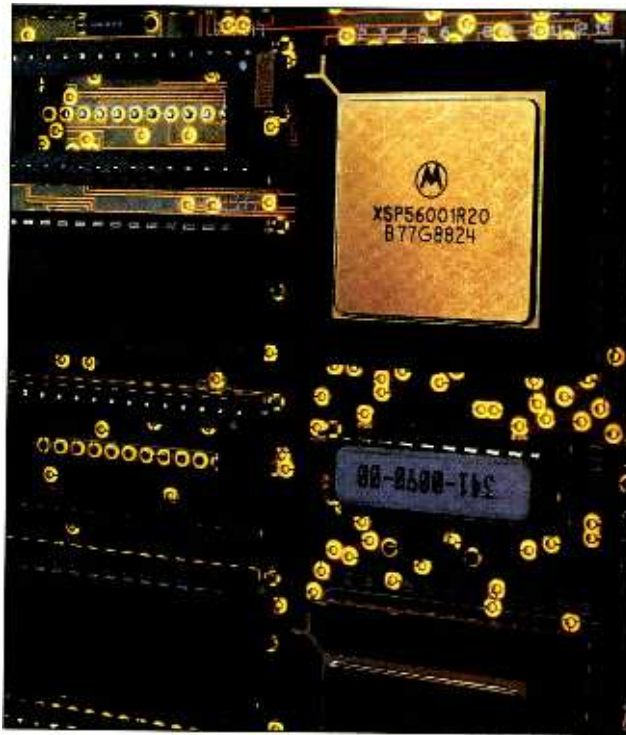
Ampex hits the top of the charts with Ampex 467 digital mastering tape.

We not only pioneered digital audio tape, we refined it. The result is Ampex 467, a tape that sets the highest standards for all digital audio applications. And it's available in all open reel and cassette formats, including the 80-minute cassette length.

More top performers record their hits on Ampex tape than any other tape in the world. While opinion may vary on what it takes to make a hit, there's no argument on what it takes to master one.

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Ampex Magnetic Tape Division  
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WHEN ASKED WHY THEY LIKED THE AUDIOFRAME,  
EXPERTS LISTED ITS 24 BIT AUDIO BUS,  
CONSTANT RATE SAMPLING, DIGITAL MIXING  
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We can give you all kinds of technical reasons to buy our new AudioFrame Production System. But if it doesn't deliver excellent sonic quality, will you care? Not likely.

That's why we designed the AudioFrame with not just your productivity, but your ears in mind. Whether you're doing music composition, sound effects design, mixing or general post editing, sound quality is critical. So we packed the AudioFrame with unique features that keep your sound completely in the digital domain. That way, you can keep your ears, and your clients, completely captivated.

**Plug into technology with a present and future.**

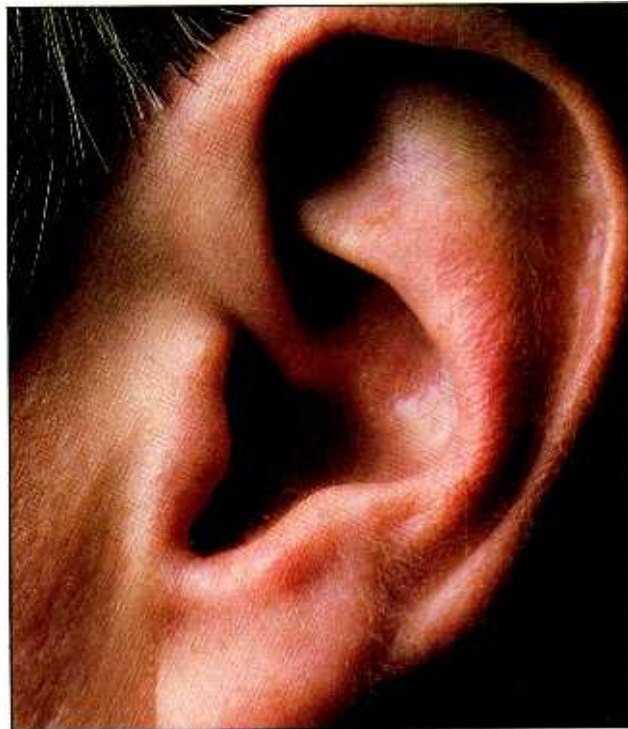
The core of the AudioFrame is our Digital Audio Bus.™ This 24 bit, 64 channel bus works in conjunc-

tion with our Constant Rate Sampling technology to provide a true digital environment for your work. Dramatic non-aliased transposition, virtual editing, digital mixing and processing can all be accomplished without sacrificing timbral integrity. Phase coherency is maintained throughout the production process. So listening fatigue is reduced and artistic values are preserved.

**Make the connection.**

Another one of a kind feature of AudioFrame is its communication capability. Our Universal Digital Interface (UDI) is multi-lingual, speaking most professional digital standards. Plus it gives you the advantage of format and sample rate conversion in real time.

The DSP is a unique module in our system. It's a 24 bit, 16 channel mixer/processor that plugs right into the Bus. The equalizer is capable of 60 dB cuts



## OF COURSE, THERE MAY BE A SIMPLER EXPLANATION.

with Qs up to 100. All control moves are fully de-zippered and real time. So you get analog feel with digital power. Plus you get features you'd expect on a full function mixer, coupled with many you wouldn't. Like dynamically automatable control settings and user-definable stored set-ups.

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The AudioFrame also gives you creative tools that streamline the production process from beginning to end. You get Texture, our full-featured MIDI sequencer and EventProcessor, our SMPTE/EBU (VITC/LTC) based time code Edit Decision List. Plus we offer the graphic signal editor and powerful sound design tools of SoundProcessor.

Put it all together, and you've got a package that will really set people on their ears. Give us a call and we'll send you the raves AudioFrame has gotten

from those who own one. People like Rob Arbittier, programmer/synthesist for Stevie Wonder, or Grammy award-winning film composer James Horner. When it comes to the best sound, they can really give you an earful.

Complete systems start at \$48,900. Lease packages available.



### WaveFrame Corporation



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Telephone 01-388 5392 for latest information and prices

## Joining the Neotek Elite

In recent years, Neotek consoles have gained a reputation for being the best-sounding desks available at any price: not because of glossy campaigns, but from personal recommendations.

Many engineers and producers in the States have already benefitted from the superior sonic quality and flexibility of Neotek equipment. Stevie Wonder, Fleetwood Mac and Bose Corporation are a few of the many American users for whom only the best was good enough. Now Music Lab is making these sought-after consoles available to UK studios.

Sound quality and flexibility are the secrets of the Neotek phenomenon. The hybrid circuits used in the Elite help to make its technical performance superior to 16-bit digital recorders in terms of noise, distortion and bandwidth. This clarity, coupled with the unrivalled warmth and

transparency of the four-band equalization section, has earned the Elite its reputation: and yet it actually costs *less* than many of its competitors.

The Elite also features Neotek's unique "Dual Channel Architecture". The desk behaves like two superimposed consoles, with each input module having a pair of audio paths, for unparalleled subgrouping and mastering power.

Ray Russell heard about the Neotek through the grapevine. "I got no bad reports at all, and I thought it was too good to be true: that's why I had to see it". Now his new Elite is earning its living at Last Chance Recordings. "It's the most flexible desk I've ever worked at. I can't sing its praises highly enough".

To find out more about the Neotek Elite, Esprit and Essence consoles, contact Paul Eastwood at Music Lab.



The Neotek Elite: widely acknowledged to be the best-sounding console at any price

## HEAVYWEIGHT CONTENDER FROM TASCAM



Forget the portastudio - the Tascam ATR-80 is a truly professional 24-track recorder

Tascam have long been known for their expertise in producing low-cost, high quality tape recorders and mixers. Now, the company's ATR-80 machine is making a big impact on the professional 24-track market. With full-function remote and autolocator options, and a full 14" reel capacity, this is a recorder that any studio can be proud of.

Music Lab are London's only authorized ATR-80 suppliers. If you are looking for a new high-quality 24-track recorder - call us to arrange an immediate trial.

## ROUND-THE-CLOCK AMPEX

Music Lab are now offering free delivery on complete cartons of Ampex tape to their London account customers - any time, seven days a week. Non-account customers can also take advantage of the service for a nominal £6 delivery charge. Just telephone Music Lab on 01-388 5392 (days) or 01-387 9356 (nights and weekends) and quote your credit card number.

# COMPANY ANNOUNCEMENT

## Change of Company Name

### The story so far!

- 1966 - MAGNETIC TAPE MECHANISMS LTD - Based in Richmond, Surrey - is formed for the manufacture of reel to reel tape recorders.
- 1969 - Company name changes to MAGNETIC TAPES LTD. Brand name CHILTON introduced, derived from name of factory, Chilton Works.
- 1971 - Product range expands to include the M Series of audio mixing desks. Beautifully finished in solid teak with black anodised control panels, they prove an early commercial success.
- 1976 - Owing to the demise of reel to reel due to the difficulty in obtaining specialised parts, a new range - the QM series of consoles - is introduced. The successful M series is replaced by the CM series modular broadcast/production desk.
- 1985 - Company purchases 6,000 sq. ft. factory in Ashford Middlesex.
- 1986 - January - move into new factory is completed. Company achieves full export order book for CM2-4 desks.  
Receives trial order from BBC Local Radio for seven QM3 24/8 consoles with modifications. This is based on reports on 2 standard QM3 24/8 consoles supplied to BBC Radio Leicester and to BBC Radio Merseyside.
- 1989 - Company name changes to CHILTON AUDIO LTD. Brand name CHILTON continues.

### For the record

No fewer than 36 QM3 consoles have now been supplied to BBC Local Radio for new O.B. vans and A stations.

In other fields the CM2, with its excellent reliability, has demonstrated that it is ideal for the Community and Hospital Radio.

### CHILTON AUDIO LTD.

Chilton Works, 6-8 Wolsey Road, Ashford, Middlesex, TW15 2RB

Phone: 0784 247124

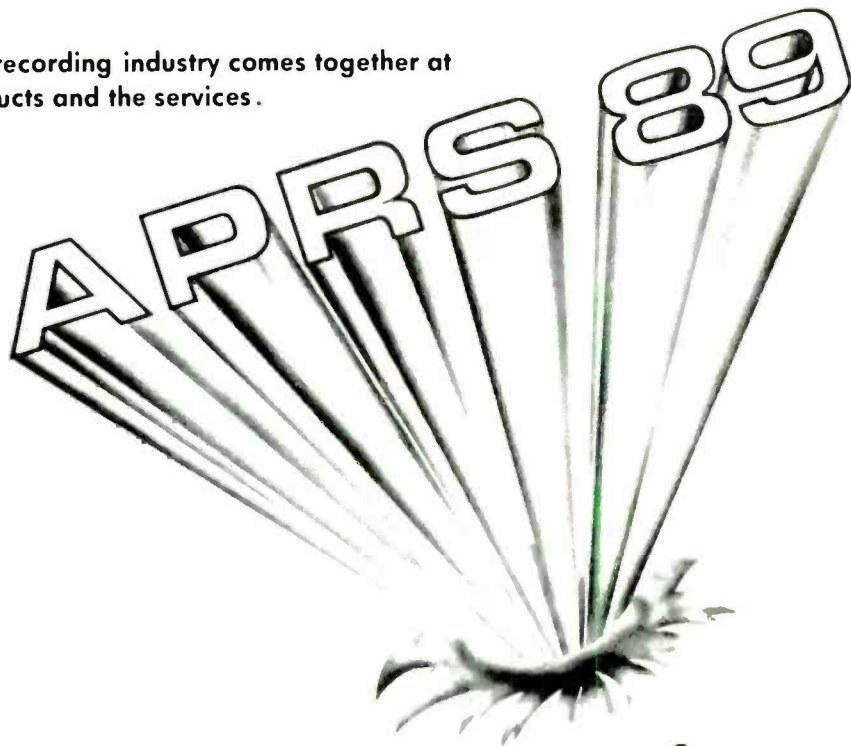
Fax: 0784 240159

For fuller details on the CM Series please contact Paul Reps.

## **BE THERE!**

All that's new in the international recording industry comes together at APRS 89. The technology, the products and the services. Simply the latest and the best.

From 7th-9th June next, at Olympia 2 in London, APRS 89, the 22nd annual exhibition of professional recording equipment will draw technically qualified visitors from around the world.



## **BE THERE!**

For more information please contact the organisers:

Association of Professional Recording Studios Ltd,  
163A High St, Rickmansworth, WD3 1AY, England. Tel: (0923) 772907 Fax: (0923) 773079.



# Dudderidge acquires Focusrite

Philip Dudderidge who recently retired as chairman and marketing director of Soundcraft, has announced his acquisition of Focusrite Ltd.

"Focusrite products have earned themselves a fantastic reputation and I am pleased to have been in a position to establish a new company to continue their production," says Dudderidge.

Rupert Neve has agreed to provide

ongoing consultancy to the new company, Focusrite Audio Engineering Ltd, and a new engineering team is being assembled under the direction of John Strudwick.

**Focusrite Audio Engineering, Temple House, Marlow Road, Bourne End, Bucks SL8 5TD, UK. Tel: 0628 810910.**

## Rupert Neve joins Amek

Rupert Neve has joined Amek to develop a new and advanced range of equipment and make some circuit enhancements to the existing Amek range.

Says Nick Franks, Amek's

Chairman: "Working in close conjunction with Rupert Neve, we hope to revitalise the original pioneering spirit of the pro-audio industry, which has largely evaporated over the past decade."

## ADM Technology acquired by investor group

ADM Technology has been acquired by an investor group. ADM designs and manufactures professional audio equipment for the broadcast industry, as well as video post-production and auditorium sound enhancement.

Products include audio mixing consoles, distribution amplifiers and a wide range of audio rackmounted

equipment.

The investor group includes Dewey Norton, who has been appointed president and CEO, and Richard Stienon, who has been appointed vice-president of marketing. Robert Bloom, the founder of ADM Technology, has been retained in a consultative role.

## Exhibitions and conventions

**June 7th to 9th APRS 89, Olympia 2, London, UK. Contact: APRS Secretariat. Tel: 0923 772907.**

**June 17th to 22nd 16th**

International Television Symposium and Technical Exhibition, Montreux, Switzerland.

**June 27th to 29th 4th regional AES Convention, Tokyo, Japan.**

**September 10th to 13th The Light & Sound Show '89, Olympia 2, London, UK. Contact: Clare O'Brien, O'Brien Associates Ltd, 10 Barley Mow Passage, Chiswick, London W4 4PH. Tel: 01-994 6477.**

**September 18th to 21st Media Visie 89, RAI International Exhibition Centre, Amsterdam, The**

Netherlands. Contact: RAI Europaplein, 1078 GZ Amsterdam. Tel: (0) 20-549 12 12. Fax: (0) 20-461006.

**October 3rd to 9th World Broadcasting Symposium Geneva, Switzerland.**

**October 19th to 22nd AES 87th Convention, New York, USA. Contact AES, USA. Tel: (212) 661-8528.**

**October 25th to 28th Broadcast 89, Frankfurt, West Germany.**

**November 28th to December 3rd Sound Expo/China '89, Shanghai Exhibition Centre, Shanghai, China.**

**1990**

**March 30th to April 3rd NAB, Atlanta, GA, USA.**

## News from the AES

As you read this column you may still be in time to attend the **Sound Reinforcement**

**Engineering Conference** being held at the IBA, Brompton Road, London on 23rd and 24th May, 1989. Under the chairmanship of Peter Mapp, a **comprehensive array** of papers is being presented by leading industry figures covering all aspects of sound reinforcement technology.

Our next lecture will be on Tuesday 13th June when Courtney Nicholas of Audio Engineering Services will talk on **Studio Acoustics**. "Studio Acoustics and the parameters that go to produce a suitable studio have not changed for many years. This is not to say that the subject is not full of misconceptions and poor understanding, such that some still say that it is a black art. In recent years, the **pace of studio construction** has accelerated with buildings and locations that hitherto would not have been considered practical, now seen as having to be used or considered. This has meant the introduction of **lightweight and prefabricated constructions** alongside the traditional heavy mass constructions. Construction times have also decreased such that a

48-studio complex can be considered in 18 weeks from concept to completion.

"There have also been developments in computers and measurement equipment that now gives us a better understanding of acoustics and enables us to correct and enhance the acoustic environment. Such items are **Reflection Phase Gratings and Time Delay Spectrometry.**"

The lecture will demonstrate the above points with a **comprehensive slide show.**

The subject to be covered on Tuesday 11th July will be **Analogue to Digital Converters.** Details will appear next month.

Other future AES events to note are the **4th Regional Convention** being held in Tokyo between 27th and 29th June and the **87th Convention** to be held in New York between 19th and 22nd October, 1989. Also you may like to note that the British Section will be running another conference on 12th to 13th September, 1989 on the subject of **AES/EBU Interface.**

For further details on any of the above or information on joining the AES, please contact: **Heather Lane, AES British Section, Lent Rise Road, Burnham, Slough SL1 7NY, UK. Tel: 0628 663725.**

## The Bridge chooses IAC

Post-production company Silk Sound have awarded a £100,000 studio design and construction contract to Industrial Acoustics Company (IAC). They have been commissioned to convert an existing area at The Bridge Studios, in Great Marlborough Street, London, into a new studio suite with adjacent voice booth.

Robbie Weston, director of Silk Sound, chose IAC after seeing them complete Sky TV's studios on schedule, also IAC's pre-fabricated approach was seen to be an advantage as the noise and mess created by conventional building techniques would disrupt adjacent studios in constant use.

## Courses and seminars

**May 23rd to 24th Sound reinforcement engineering conference. Contact AES (British Section), tel: 06286 63725.**

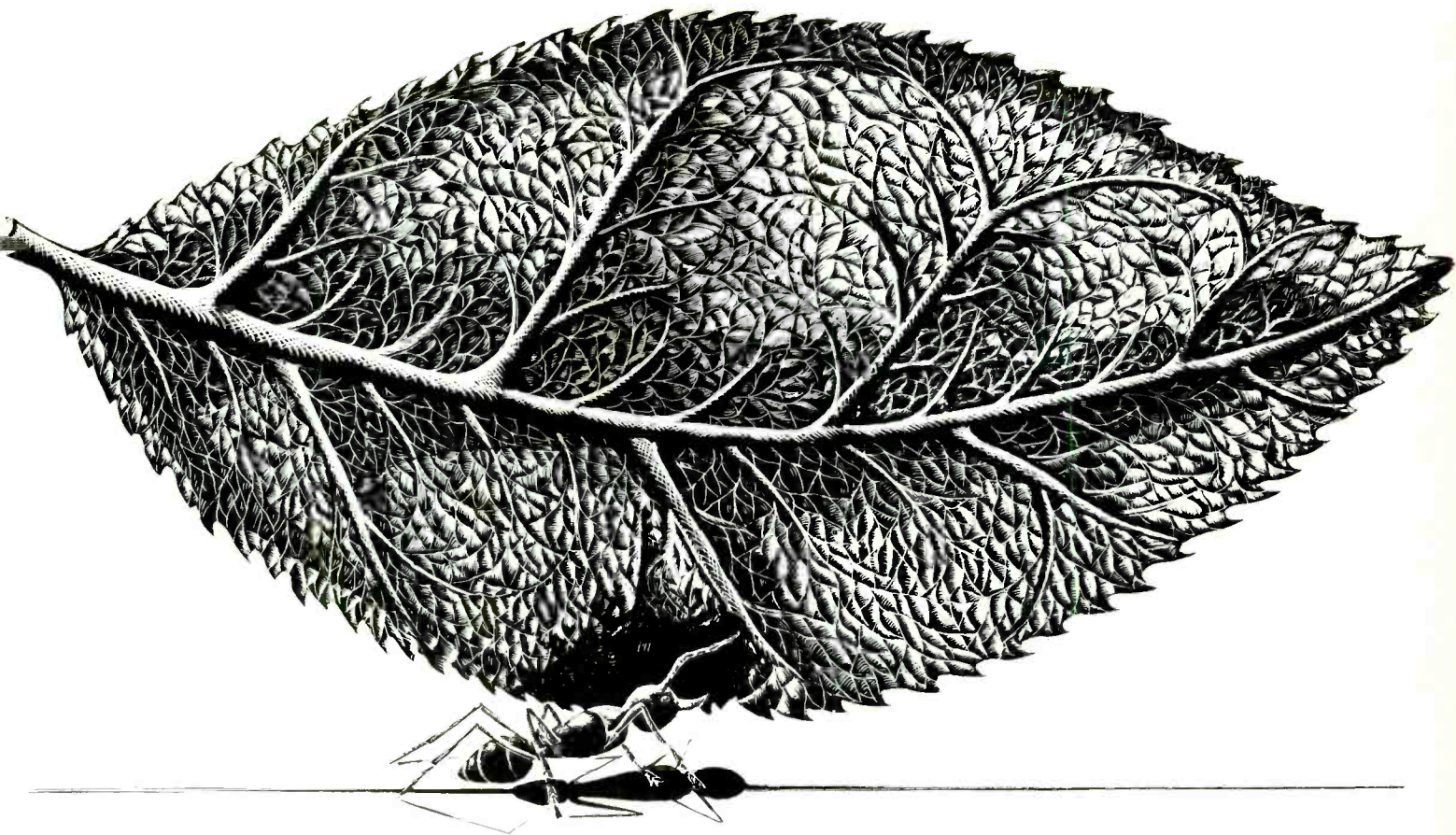
**June 13th Studio Acoustics. Contact: AES (British Section), tel: 06286 63725.**

**July 11th High resolution ADC. Contact: AES (British Section), tel:**

**06286 63725.**

**August 26th and 30th Soundscape. The University of East Anglia, Norwich, UK. Contact: Jane Thorp, UEA. Tel: 0603 592802.**

**September 12th to 13th AES/EBU Interface. Contact AES (British Section), tel: 06286 63725.**



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The leafcutter ant perfectly demonstrates the design philosophy behind Carver amplifiers—to pack the most power into the lightest, smallest package. The latest addition to the range weighs in at only 10lbs with an output of 465 Watts RMS per channel into 8 ohms. Tested – and proven – on some of the biggest and toughest tours ever to go on the road, 108 Carver units were used by Clair Brothers

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*Carver is available through:*

**Audilec Distribution Ltd**, Laindon West, Essex. Tel: 0268 419198. **Bodley Knose Ltd**, Guildford, Surrey. Tel: 0483 68296 and at: Dewsbury, Telford, Southampton.  
**Concert Systems**, Manchester M1. Tel: 061-274 3859. **Kelsey Acoustics**, London W11. Tel: 01-727 1046. **KGM Studio Specialists**, Wakefield, West Yorks.  
Tel: 0924 371766. **McCormacks Ltd.**, Glasgow. Tel: 041-332 6644. **Peats Wholesale Ltd**, Dublin 1, Eire. Tel: 0001 722577. **Pro Wires**, Sidcup Kent. Tel: 01-302 0056.  
**Sound Control**, Belfast. Tel: 0232 772491. **Sound Control**, Dunfermline, Fife. Tel: 0383 733353 and at: Edinburgh, Dundee, Glasgow, Kircaldy.  
**Windmill Munro Design Ltd.**, London W1. Tel: 01-434 0011.

# GLW Enterprises acquires Harrison Systems

GLW Enterprises have announced that they have acquired the assets of Harrison Systems. GLW are now manufacturing the Harrison line of consoles in GLW's manufacturing facility in Nashville.

Although David Harrison did not have any equity or financial interest in GLW Enterprises he has been retained as a GLW employee

providing solely engineering and other technical services.

GLW say they're in a position to begin manufacture of Harrison consoles straight away and also ready to provide after sales service on existing Harrison consoles. GLW Enterprises, 437 Atlas Drive, Nashville, TN 37211, USA. Tel: (615) 331-8800

## THX sound system for Prominent studios

A Lucasfilm THX Sound System has been installed in a film preview theatre in Camden called Prominent Studios. With only 26 seats Prominent is by far the smallest cinema in the world to have received this system.

THX uses a system design incorporating selected audio equipment and carefully controlled acoustics. The system is certified 'THX' only when the installation

meets required acoustical and sound performance standards. Measurements are taken twice a year by THX representatives. Chris Pearce, Prominent's administrator, believes that there is a need within the film industry for a preview theatre with such a high standard sound system, so that film makers and distributors can have high quality sound right from the rushes stage.

## Letter: Reims review

Dear Sir, Following Dave Foister's excellent review of the Reims console (*Studio Sound* May), we thought it appropriate to clarify a couple of points:

The whole console is scanned in under 1 ms at a repetition rate of 1 kHz, any recorded event will be replayed within 1 ms equivalent to two SMPTE bits or ¼ subframe at 25 fps. The switches have a ramp time of 15 ms to avoid thumps on low frequency signals.

Software to enable transfer of advice data to and from the St's is already in place, with the equivalent software for both IBM's

and Macintoshes under development. Future software enhancements will be released on floppy disk formatted to the appropriate standard.

The most recent addition to the capabilities of the system is 'MIDI Merge' allowing MIDI OUT to reflect both external and internal MIDI information. This will be shown along with other enhancements at APRS.

Yours faithfully, Jon Ridell, Paul Hardcastle, Harman (Audio) UK Ltd, Unit 3, Bittern Place, Coburg Road, Wood Green, London N22 6TP, UK.

## Letter: Magnetic Tape Supplies in Europe

Dear Sir, Too much credit has been given to BASF and unjustified suspicion cast upon 3M: neither did BASF invent magnetic tape, nor did 3M steal the manufacturing process. Seen strictly from the point of patent law, magnetic tape was invented by the New Yorker Joseph A O'Neill, to which US Patent 1,653,467 (Dec 20th 1927) bears testimony. In fact, probably the only application of this patent was that it had to stand as the main argument against the German Patent DRP 500 900 (of Jan 31st, 1928) in 'successful' nullity proceedings in 1936. DRP 500 900, granted to Fritz Pfeumer, a paper engineer living in Dresden, is the actual patent of invention for magnetic tape. BASF can be credited with having developed, by 1934, a product which had reached the production stage from the preliminary work carried out by Pfeumer.

Taking the O'Neill patent into account, 3M could not, therefore, have 'stolen' the BASF process at all and did not even need to. As early as September 1st, 1944, in fact, Dr Otto Kornei, a colleague of Dr S J Begun at the Brush

Development Company, Cleveland, OH, USA, had suggested to 3M that they should manufacture an oxide magnetic tape and 3M had started production. This took place, it should be noted, before the decisive breakthrough was made with the Magnetophon technology, which had been transferred from Germany, thanks to the efforts of John T Mullin, in the USA. After all, after 1945 German patents were considered 'captured enemy equipment' and released for general use and for this reason alone the activities of 3M were legal.

It should also not be forgotten that, until the beginning of the '50s, significant encouragement in the further development of magnetic tape came from the USA, especially with regard to the transition to (relatively) high coercive and needle-shaped iron oxides. The difficult economic situation in post-war Germany was one of the main reasons why far-reaching innovations were not possible here until the mid-'50s. Yours faithfully, Friedrich Karl Engel, D-6940 Weinheim-Hohensachsen, Jahnstraße 13-1, West Germany.

## Jean-Michel Jarre: a postscript

In our feature on the Docklands concerts (*Studio Sound*, February 1989) we omitted to mention Fleetwood Mobile's role in the sound production.

Fleetwood Mobile co-ordinated all the audio requirements for both the live radio broadcasts (BBC Radio One and French radio) and TV recording.

Fleetwood's major additional task—since the shows were mixed in mono—was to capture the atmosphere of a live concert.

To solve the problem they added a stereo audience sound mix using

Sennheiser 816s, 416s and 451s—routed mid-way through BSS active splitters—and four Tandy PZMs located on the mobile's roof: a total of some 30 'ambience' microphones around the site. Each mic had its own tape track for post-production correction of time delays.

The system took three days to install and involved 5 km of mic cable, and was (according to Fleetwood's Andy Turner) "a complete success despite the unusual circumstances."

## In brief

● BBC director-general Michael Checkland has announced that BBC1 and 2 will start a stereo television sound broadcasting service in the Autumn. The Nicam 728 digital stereo system, developed by BBC engineers, will carry the stereo

programme sound.

● The name Recording Studio Design plc (RSD) is to be dropped completely from the Studiomaster title, the company will now be known as Studiomaster (UK) plc.



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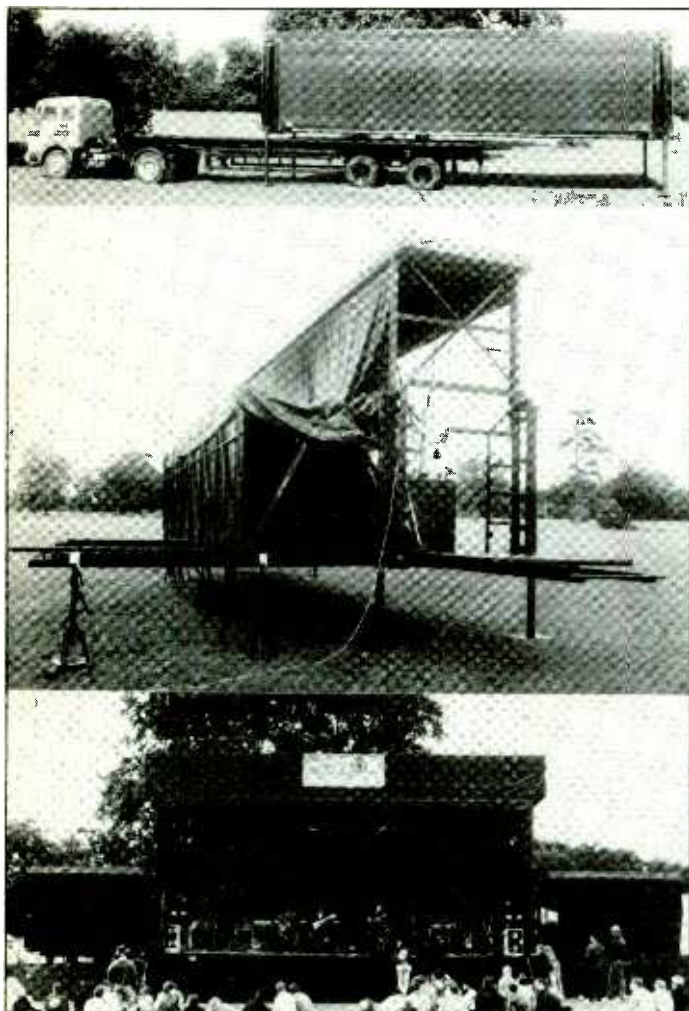
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## Contain-A-Stage

*Contain-A-Stage 500* is a new concept in mobile stage equipment and has been designed and built by Star Hire especially for outdoor events and exhibitions.

In collapsible mode it weighs around 15 tonnes and measures 40x8½ ft. Fully erected, *Contain-A-Stage* opens out to provide a fully weatherproof curtained stage with a usable deck area of 36x24 ft, and a roof clearance of 9 ft at the back

rising to 16 ft at the front.

It has its own generator to supply power to electric and hydraulic services and lighting rigs. The whole stage can be fully erected in two hours with outswinging jacks and curtains under automatic pushbutton control. After use it is restowed and can be off site within one hour.

**Star Hire, Milton Road, Thurleigh, Bedford MK44 2DG, UK. Tel: 0243 772233.**

## Gateway courses

Gateway have announced two new courses. The first is a weekend devoted entirely to the miking of drum kits and acoustic instruments. The course has been written and is taught by David Kenny manager of Ideal Sound Recorder Studio and ex-chief engineer at Gateway.

The second course is devoted to MIDI/sequencing and is written by Graeme White. The course can be taken over a week or can be spread over three weekends.

From the Gateway Organisation there's also news of the foundation of a new jazz school starting in October.

## Agencies

• Synton of Holland have signed an agreement with **Adams-Smith** to distribute their synchronisers in the UK, Benelux, Finland, Norway, Sweden, Denmark and Italy. Synton International BV, Computerweg 1, 3606 AV Maarssen, The Netherlands. Tel: 31-3465 69664. Fax: 31 3465 73330.

• **Anek Systems and Controls** have appointed a distributor for Turkey. Reysas, Mahatma Ghandi Sok, 78/2 Gaziosmanpasa, Ankara, Turkey. Tel: 4 146 1065. Fax: 4 146 1081.

• Michael Stevens & Partners have announced their appointment as dealers for **Westlake** monitoring equipment. Michael Stevens & Partners, Invicta Works, Elliott Road, Bromley, Kent BR2 9NT, UK. Tel: 01-460 7299.

• **Saturn Research** have appointed Uduco as their distributor for Saturn

tape machine in France. Uduco, 26 Rue des Tourelles, 75020 Paris. Tel: 43 63 9745. Fax: 42 71 4372.

• **Bruel & Kjaer** have appointed Professional Studio Equipment as sole distributor in Denmark of the complete range of 4000 series microphones. Professional Studio Equipment, HD Andersengade 22, PO Box 1102, DK-5100 Odense C, Denmark. Tel: 45 66 14 5958. Fax: 45 66 14 9181.

• Stanley Productions of London have been appointed UK distributors of the Japanese **MDC Master** recording lacquers. Stanley Productions, 147 Wardour Street, London W1. Tel: 01-439 0311. Fax: 01-437 2126.

• **Allen & Heath** have announced the appointment of HHB Communications, 73-75 Scrubs Lane, London NW10 6QU as their London dealers.

## Letter: Registering generic terms

Dear Sir, It would appear that in certain countries the attempt to pirate rights into private ownership for generic expressions in the audio-visual industry is still going on. From an International Surveillance Service, which we operate on applications to register trade marks throughout the world, we have noted an attempt in Argentina to register 'Master tape' for cassettes

and recently 'DAT-Digital Audio Tape' in Brazil. However, we suspect that if the owners of these attempted registrations try to enforce them they are likely to receive a dusty answer from the trade.

Yours faithfully, Ian C Baillie,  
**Ladas & Parry, 52-54 High Holborn, London WC1V 6RR, UK.**

## Address changes

• **Audio Visions**, the A/V production house have moved into a purpose built facility at 1 Bowes Hill, Rowlands Castle, Hants PO9 6BP, UK. Tel: 0705 412911. Fax: 0705 413286.

• **Quantel** the sister company of Solid State Logic within the UEI Group, are to operate alongside SSL in their newly extended sales and service centre in Los Angeles. Quantel's new address is 6255 Sunset Boulevard, Los Angeles, CA 90028.

• **TDK UK Ltd** have moved to TDK House, 5-7 Queensway, Redhill, Surrey RH1 1YB, UK. Tel: 0737 773773. Fax: 0737 773805.

• **GML Inc** has relocated to a larger facility at 8721 Burnet Avenue, Van Nuys, CA 91405, USA. Tel: (818) 781-1022. Fax: (818) 781-3828.

• **Computer Music Systems**, specialists in IBM PC based music

software, have moved to 5-7 Buck Street, London NW1 8NJ, UK. Tel: 01-482 5224. Fax: 01-485 9302.

• **Twinmusic Studio** of Holland have moved to Markt 23-24, 6446 Ad Brunssum, Holland. Tel: 045 213 768.

• **Pan Communications** have relocated to 1-12-12, Akasaka Minatoku, Tokyo 107, Japan. Telephone and fax numbers haven't changed.

• **Raper & Wayman**, UK pro-audio supplier, have moved to Unit 3, Crusader Industrial Estate, 167 Hermitage Road, Haringey, London N4 1LZ, UK. Tel: 01-800 8288. Fax: 01-809 1515.

• **HES Electronics** of Belgium have moved to Vliegwezenlaan 10, B-1730 Asse-Zellik, Belgium. Tel: 466 8180. Fax: 466 9157.

• **Digitec** of Paris, France, have changed their telephone number to 34 80 7500.



## Take a fresh look at the industry standard for DAT mastering.

Amongst audio professionals, the Sony DTC-1000ES is now widely recognised as the DAT standard. It's officially supplied by HHB – Sony's leading independent distributor. That means genuine service and spares support, as well as expert advice.

Second generation DAT hardware incorporates rationalised integrated circuitry and single A to D conversion. This may make DAT more accessible to consumers, but it's bad news for the audio professional. That's why we've talked to Sony and secured an extended production run for the DTC 1000ES.

Along with twin A-D conversion, all DTC 1000ES recorders from HHB are now specially adapted to record at 44.1kHz as well as 48 kHz. A modification that's impossible to implement in most



second generation devices. For additional professional convenience, we've even designed an optional 19" rack tray.

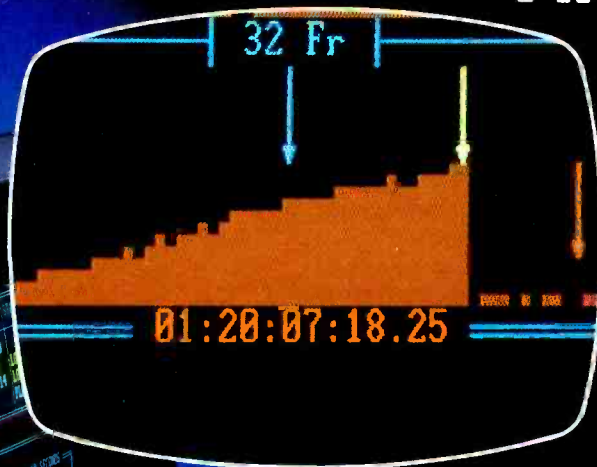


If you're thinking about a secure future with highly-affordable DAT mastering, take a fresh look at the new DTC-1000ES package from HHB. It's just one member of a powerful family of DAT equipment available from the industry's most experienced supplier of digital recording hardware.



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## People

- Sony's Pro-audio division have named Osamu Tamura as the new vice-president. Tamura has been with Sony for 20 years and was previously general manager of the Sony Broadcast's UK Audio Division. His new job is based in New Jersey, USA. Sony have named Chris Hollebhone as his successor.
- Hill Audio, Kent, UK, have appointed Derek West as UK sales manager. This appointment is a direct result of Hill Audio's plan to establish a comprehensive UK dealer network. West joins Hill Audio following 10 years at Tannoy as both sales manager and export manager.
- Solid State Logic have announced the appointment of Piers Plaskitt as chief executive of Solid State Logic Inc. Plaskitt was formerly SSL Inc vice-president.
- Orban have named David Roudebush marketing and sales manager for their professional products (the *Blue Panel* line). Roudebush most recently had been sales manager at Otari Corporation.

- Robin Millar, chairman of the Scarlett Group of companies, has appointed Colin Fairley to head **Scarlett Studios**, which includes Power Plant and now Maison Rouge. Fairley had been an independent engineer/producer and before that spent 10 years at Air Studios.
- Amek have appointed Henry Goodman recording product sales engineer. He was formerly Amek's sales co-ordinator.
- Peter Marchant has rejoined the BBC as chief engineer, television. He was previously deputy director of engineering at ITN.
- Bose UK Ltd, have announced the resignation of their managing director of 18 months, Alan Kilford. He is leaving Bose to pursue other interests in related areas of the industry.
- Solid State Logic's film product manager, Chris David, has relocated from SSL's Oxford headquarters to the company's Western Region office in Los Angeles. SSL have also announced the appointment of Dave Collie as product development manager.

## In brief

- Farmyard Studios, Little Chalfont, Bucks, UK have been bought by Jetta Studios Ltd. The purchase includes the studio and the name 'Farmyard Recording Studio'. Jetta Studios is a new company headed by classical music conductor and composer, Ahmet Ertegun. Farmyard's only two previous directors, Rupert Hine and Trevor Morais, have been appointed to the Jetta board.
- Transco Mastering Services is a new company formed to service the needs of studios committed to disc cutting, CD preparation and audio post-production. Transco are the exclusive UK distributor of Transco Mastering blanks with stocks of 10 inch, 12 inch and 14 inch masters and 7 inch and 10 inch playbacks now available in the UK. TMS Limited, 250 Hillbury Road, Warlingham, Surrey CR3 9TP, UK. Tel: 08832 2914. Fax: 08832 2606.
- Ensoniq Europe, a member of the Synton Distribution Group, Maarssen, Holland, is no longer

- involved in the exclusive distribution of Ensoniq products in Europe. The US manufacturer, Ensoniq Corporation, has terminated the agreement.
- Pro-audio distributor, Scenic Sounds Equipment Marketing Ltd, have changed their name to **SSE Marketing Ltd**.
- 1989 sees the tenth birthday of the **Revox B77** tape recorder.
- Films of Bristol is a new company which has been formed to provide 'one stop, one invoice, film, radio, video and audio production facilities'. They offer digital sound production based around the New England Digital *Synclavier* system, with on-line effects and music library, controlled via an SSL 32-channel 6000 series console
- Digital Audio Research, Surrey, UK, have produced a demonstration video of the *SoundStation II*. The video, which runs for 15 minutes, will be available to potential *SoundStation* customers. Digital Audio Research. Tel: 03727 42848.
- HHB Hire & Sales, European pro-audio supplier, have changed their name to **HHB Communications**.

## Sidechain

Microphones. Where would any of us be without them? Pete Townshend would have had nothing to boot off stage, or Hendrix to slide his guitar up and down. And Rod Stewart would have been empty handed strutting across the stage. And that's just the stands. What would Roger Daltrey have twirled around his head and out over the front rows of the audience. Heaven forbid what might have been the consequences had the star-launched mic jettisoned its cannon and zoomed off into the realms of the outer auditoria. Probably a half-dazed fan waiting at the stage door afterwards to get the bump on his forehead autographed!

But where would those fans have been had the cable returned to Daltrey micless? Great, climactic words such as 'See Me, Feel Me, Touch Me, Heal Me' would never have been sung. Towser would have had nothing to do a scissor jump to. He'd have been, well, legless!

Our poor mic-struck fan would have 'felt it' all right.

That the mic never did, in all those hundreds of performances around the world, set off in free-flight, and always stood up to the twirling and banging sufficient to deliver Daltrey's words with all the sensitivity, or

'loudibility' they deserved says a great deal about modern microphone, connector and cable technology. And one might easily be led into thinking that a microphone is an extremely complicated piece of equipment. It is!

But, it was during a lecture on magnetism and microphones, part of a training course at BBC Langham, that our ears, and minds, were given the most interesting and astonishing treat even better than Ovaltine (trainee BBC producers and studio managers were nicknamed Ovalteenies). When the instructor proceeded to construct a 'microphone' out of only three parts. A ring magnet, a coil and a plastic BBC teacup. He went on to better this by constructing a 'speaker' in the same way.

OK, the quality was a bit 'mashed'. In fact, almost as good as the quality of those early radio broadcasts. So that's how the BBC managed their wartime broadcasting. Next time you're short of a teacup, just look inside an old radio set!

The similarity between mic and speaker construction recalls the story of a young and very inexperienced engineer (myself) who wrongly connected the leads from a pair of 'studio' (not control room) monitor speakers, to the microphone inputs of the console, and then couldn't figure out why he could hear people in the

studio. Ghosts in the machine!

Microphones have a certain mystique, a daunting, almost eerie, 'presence'. Unless one is in control of the console, one never knows for sure whether a mic is actually 'live' or not.

The classic story, almost a legend, is of the day romance blossomed in a broadcasting studio. On that day, in that control room, it was love at first sight for a balance engineer and his lady tape-op.

The atmosphere, after a session is often, not only one of deafening silence and emptiness but one of 'aloneness'. In this case, it was a certain 'we're aloneness'.

Unable to control himself, the young man exercised his arts of seduction blissfully unaware in his unbridled passion that he was also pressing on the button for the console-mounted *D202*, which relayed dutifully and with incredible clarity, every word, sign and heart-felt murmur, into the mix bus and out to the network. Though not on-air, it was nevertheless, by this time, being tuned into by everyone else in the building.

A close encounter of the 'live' kind!

Have modern production techniques signalled the demise of the microphone. Are they destined



to the cupboard next to the echoplate? Come to think of it, is the echoplate doomed?

Will tomorrow's recording engineers ever perceive and be thrilled by the spine-tingling 'eureka' type experience achieved by moving the mic 1 cm, to the left, the right, backwards or forwards, in front of 100 musicians!

Let us raise our plastic teacups and toast our humble begetter.

● Any classical music buff might be appalled to learn that the 4-note signal, used by the BBC World Service to keep its transmitters switched on during long intervals between programmes, is actually taken from the beginning of Beethoven's 5th Symphony.

Now, an enterprising company has 'cocked a snoot' at the BBC, by using the first seven notes of the soap opera *EastEnders* theme tune in a door-chime for laundrettes.

# Contracts

- The Home Service has received an order from Virgin to supply a 144 mic input version of the **Raindirk Symphony** for their refitted Virgin Manor Mobile. The Home Service has also supplied Virgin-owned Olympic Studios, London, with three pairs of the **Genelec 1035** main monitoring System.
- Recent **Eastlake Audio** projects include the construction of a new 20 x 24-track digital studio for the Sintonia studio complex in Madrid; a new 48-track digital control and isolation room for Cinearte of Madrid; a second digital Disc mastering facility for Digital Press Hellas in Greece; improvements for both the studio and control room of Studio One at CBS' complex in London. Projects for 1989 include Eastlake's supervision in Bogota of the construction of a complex to house 10 radio stations for Caracol, the radio and TV broadcast operation in Columbia and the design of two large studios and disc mastering

rooms in a new multi-storey complex in Havana.

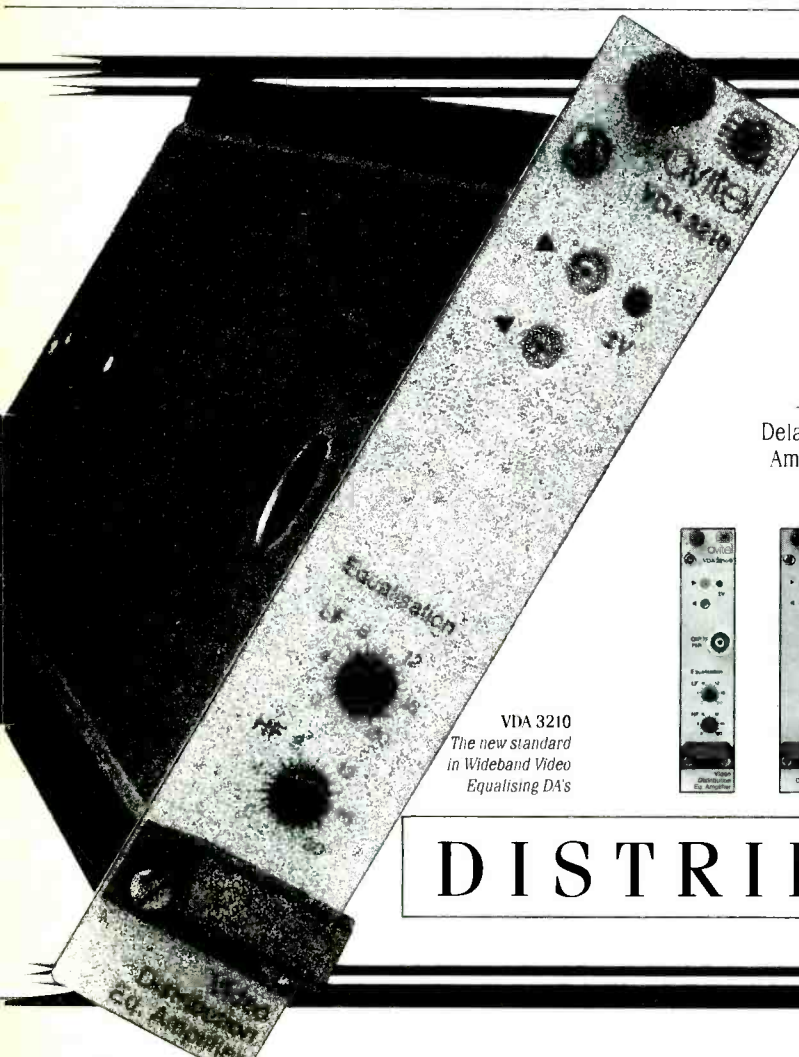
- The BBC's at Maida Vale have selected the complete **RPG Diffusor System** as the main acoustical ingredient in studios as well as control rooms. Other recent RPG clients include Radio New Zealand; Swedish and Hong Kong TV.
- The Chocolate Factory Studios, London, have installed a **Mitsubishi X850** 32-track. The X850 will be mated to their existing Trident console.
- **Fostex** have delivered a **D-20** 4-head Pro-DAT recorder with SMPTE synchronisation to the Arnold Muhren studio, Volendam, Holland.
- **Raezor Studio**, Wandsworth, London, have recently installed a 32-channel **SSL E-series** console, with synchroniser controller and **Q.Lock** system providing mix-to-picture facility. Additional new equipment also includes **Lexicon 480L** digital effects system; two **Studer A820** 2-track master recorders; a stereo **Dolby 363 SR/A** unit; **AK** timelink **Gearbox** and a **Sony 5850** U-matic

with three **Sony PVM 2010** video monitors.

- Southlands Studios now have a fully integrated **DDA AMR 24 Fairlight** track laying suite based around a package supplied by Stirling Audio Systems. The package also includes **Otari MTR 1/2** inch and **1/4** inch machines; **Lexicon 480L**, **PCM 70** and other outboard devices.
- Recent orders for **Sony's PCM-3348 DASH** multi-track recorder have been received from Virgin Studios; Advision; Goldcrest; Tent Records (UK) and Studio De La Bleque (France) as well as European hire companies Hilton Sound and Audio FX. In the US users include The Hit Factory; Bob Clearmountain; Power Station; Howard Schwartz Recording (NY); The Record Plant; CMS Digital (LA) and Georgetown Masters (Nashville). Japanese studios include Toshiba-EMI's Studio Terra, JVC Aoyama and CBS/Sony's facilities.
- **DAR**, Surrey, UK, have sold a number of their **SoundStation IIs** to customers in Europe. In Italy Multivideo has purchased a 4-channel

system for TV and commercial post-production and in Germany IRT has chosen **SoundStation II** for TV and Radio post-production.

- **WaveFrame Corp**, Boulder, CO, USA, have announced recent installation of **AudioFrame** Digital Workstations. Three systems have been installed at Danish Radio in Copenhagen and single systems have been installed with Billy Cobham and Patrick Mimram in Switzerland; Chris Evans in Germany; Jonason Kuei in Taiwan; Stefan Costantini in Italy and film Composer James Horner in the US.
- **WaveFrame** are also to deliver **AudioFrame** digital audio workstations to eight new facilities — Stevie Wonder's Wonderland Studios in LA; Wonder's programmer, Rob Arbittier in LA; Sheffield Recording, Maryland; Sound Associates, New York; The Process Recording Studios, North Carolina; Trax Sound, Toronto; The University of California, Santa Barbara; and West Productions in Burbank.
- **TimeLine** of New York have



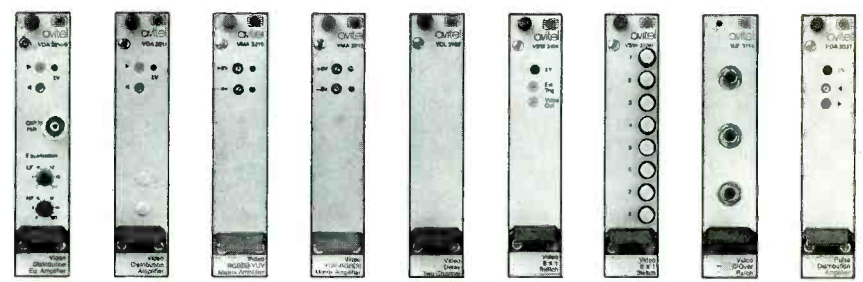
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  - Pulse Distribution Amplifiers and optional Delays up to 4µS.
  - Video Switching with Local/Remote Control.
  - Long Video Delays to 2.2µS.



# DISTRIBUTION VIDEO

recently supplied more than a dozen of their *Lynx* keyboard control units to various West Coast post-production houses. Clients include Disney and Universal Studios.

● **Digital Audio Research** have supplied an 8-channel *SoundStation II* digital audio and recording system to BBC Radio. The *SoundStation* will be used for complex programmes with a number of pre-recorded items like jingles and sound effects. DAR have also delivered a *SoundStation II* to Autograph, a UK theatre sound production company responsible for shows like *Cats* and *Les Miserables*. Autograph see *SoundStation* revolutionising the use of sound effects for theatre.

● **Trident Audio Developments** have entered into an agreement with Digital Creations in which Trident will use the Digital Creations moving fader automation system in all of their consoles requiring automation.

● **Soundtracs** have announced new sales of their *In-Line* series console to 16 studios across Britain,

including The Music Works and Aosis in London, Pace in Milton Keynes, The Colosseum Theatre in Leeds and ICC Studios on the south coast.

● Central TV have installed two **Soundcraft** series 200 *BVE* consoles, an 8- and 16-channel, in two of their Nottingham-based off-line and post-production suites. Both consoles have been installed with the recently launched *VSA24* Serial Interface, enabling the 200 *BVE*'s to work with Central's existing Grass Valley edit controllers, using the *ESAM* 1 protocol. Central now have eight *BVE* consoles in their various operations.

● PA hire company Canegreen have taken delivery of a **Ramsa SA-840** series sound reinforcement console through Britannia Row Productions in London.

● Metropolis recording complex, London, have bought two **Otari MTR-100** 24-track analogue machines from Stirling Audio as well as products from **Sanken** and **TimeLine**.

## In brief

● **Quad** have set up a new division dealing solely with professional amplifiers and customers. Allen Mornington-West has been appointed to set it up. He was previously with the IBA involved with broadcast sound standards for all UK commercial TV and radio stations.

● **ICM Holding**, Baar, Switzerland, manufacturers of compact discs and music cassettes, have acquired a major shareholder in AFE BV of Amsterdam, a subsidiary of a large Italian Industrial group. The takeover is seen to be a direct result of the continuing price collapse of compact discs, and support from a strong international partner became essential.

● **EMT-Franz**, Kippenheim, West Germany, professional audio and video equipment supplier, have been bought by Barco Industries of Belgium. The new name is now Barco-EMT, and the two new presidents are Mr Joost Verbrugge, general manager of Barco Industries,

and Mr Francois Montoya, formerly executive manager of EMT-Franz.

● **Solid State Logic** are supplying Mosfilm, the Russian State film company, with four consoles for their new Moscow music recording and dubbing theatre complex. This is part of a major expansion Mosfilm are making to attract Western film producers and artists. Engineers from the new Mosfilm 'Tonstudio' visited SSL's Oxford headquarters for training and acceptance testing of *SL 4000 G* series and *SL 5000 M* series consoles.

● **The Mobile Studio**, known to many as the Rolling Stones Mobile, has had a major re-fit. Apart from a new look, additional input channels have been added as well as a new monitor system.

● **Otari** have changed their name to 'Otari Inc', because of a decision to diversify and widen their business activities. Otari have also moved to new premises. Their headquarters is now at 4-33-3 Kokuryo-cho, Chofu-shi, Tokyo 182 Japan. Tel: (0424) 81-8626. Fax: (0424) 81-8633. Otari's factory address remains unchanged.

# AVITEL

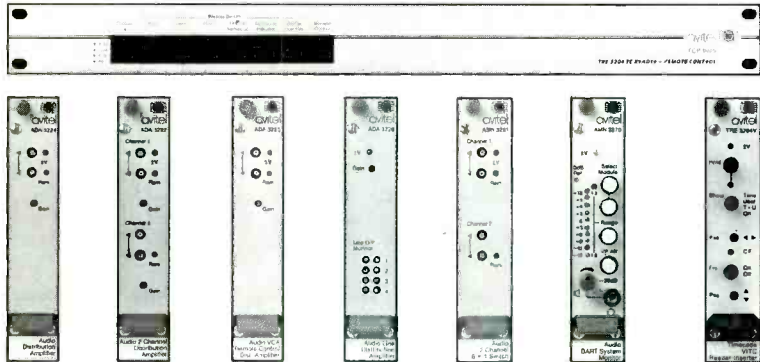
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## Soundlab active audio splitter

Soundlab Electronics have released the *AS1* active audio splitter. Built to IRT specifications, the *AS1* is a modular system each module housing 10 input channels, all split to three outputs. Each input has lockable switches for phantom power and 18 dB of gain and is balanced and earth-free.

A full range of options is available

for the system including racks, flight cases and an input/output panel with Cannon and Siemens multipins for multicore cables. An elaborate earth lift facility is also incorporated.

**Soundlab Electronic, Robert Bosch Strasse 34, 8044 Unterschleissheim, West Germany. Tel: 089 3.10.30.01. Fax: 089 3.10.20.70.**

## SCV dynamics controller and SR control unit

The *AT422* is a dual 4-band dynamics controller and the *PSD Director* is a control unit for sound reinforcement systems.

The *AT422* is designed for applications such as FM and stereo television broadcasting, CD mastering, post-production and high quality sound reinforcement and consists of a dynamics controller where each channel is split into four frequency bands, each with its own limiter/compressor/gate.

It employs low distortion VCAs and ultra low-noise ICs and features selectable pre/de-emphasis, output gain, stereo coupling and vu/peak metering. An elliptical equaliser for modifying the stereo image is also incorporated as is a soft-clipper—or peak suppressor—on the final output mix in order to prevent uncontrolled transients reaching the following equipment.

Other facilities include LED bargraph metering for input/output levels and gain reduction, electronically-balanced inputs and transformer balanced outputs, RF protection and momentary individual setup/bypass switches for calibration.

The *PSD Director* provides central control for sound reinforcement

systems with left, right, sub-bass and central cluster feeds. The cluster and sub-bass outputs can be sourced from the mixing console or derived internally in the unit via mono summing techniques and 4th order Linkwitz-Riley filtering. In addition, the sub-bass channel can be switched to full-range to provide an auxiliary feed for delay systems, etc.

The *PSD* features elliptical equalisers for stereo image processing, LED bargraph meters for each section (input or output levels), phase correlation indicators,  $\pm 12$  dB of gain control on the cluster and sub-bass outputs, insert sends and returns, secondary outputs with earth compensation for connection to OB trucks, recorders, etc, electronically-balanced inputs and transformer-balanced outputs.

Other facilities include an adjustable interstage peak suppressor for the sub-bass output and a test signal for each section consisting of a single octave tone sweepable through 100 Hz to 10 kHz.

**SCV Audio, 186 Allee des Erables, BP 50056 Paris Nord II, 95947 Roissy Charles de Gaulle Cedex, France. Tel: (1) 48.63.22.11. Fax: (1) 48.63.22.92.**

## Schoeps VMS 52 UB

The *VMS 52 UB* stereo microphone preamplifier incorporates an MS matrix and 48 V phantom powering (the *32 UB* version supplies 12 V).

Features of the unit include switchable gain of 20/40 dB, bass roll-off filter (150 Hz at 6 dB/octave) and width control for the MS matrix. The *VMS 52 UB* also has line inputs to the matrix, meaning that it can be used for decoding during post-production.

Power for the preamplifier is via internal batteries (eight AA 1.5 V) or

an external 12 V DC source. Dimensions are 157x105x50 mm for a weight of 870 g (including batteries).

**Schoeps GmbH, Spitalstrasse 20, D-7500 Karlsruhe 41, West Germany. Tel: 0721 42011/16. UK: Scenic Sounds Equipment Ltd., Unit 2, 10 William Road, London NW1 3EN. Tel: 01-387 1262. USA: Posthorn Recordings, 142 W 26th Street, 10th Floor, New York, NY 10001. Tel: (212) 242-3737.**

## JBL Sound Power additions

JBL have added three sub-bass systems to the *Sound Power* series: *4782*, the *4785* and the *4788*. All three cabinets feature a triple bandpass enclosure design and are designed to provide uniform, clean sub-bass performance to existing systems. The enclosures house a pair of 12 inch (*2204H*), 15 inch (*2225H*) and 18 inch (*2240H*) speakers respectively for  $-3$  dB points of 35 Hz, 30 Hz and 28 Hz.

The systems are designed for both touring and fixed installation applications and feature both Cannon *EP-8* male/female connectors and *XLR-3F* connector.

Also new from JBL are four horn/

compression driver mounting systems for horn mounting on a flat surface.

The *2506A* fixed-position bracket is for use with 2360 horns in JBL theatre systems and the *2508A* fixed position bracket for *2344A/2370A/2380* series horns.

The *2507* 3-way adjustable bracket is designed for the *2344/2370A* bi-radial horns and the *2509* 3-way bracket for the *2360/2380* bi-radial horns.

**JBL International, 8500 Balboa Boulevard, Northridge, CA 91329, USA. Tel: (818) 893-8411.**

**UK: Harman (Audio) UK Ltd., Mill Street, Slough SL2 5DD. Tel: 0753 76911. Fax: 0753 35306.**

## In brief

• The **Analog Digital Synergy** *Synergy One* digital console (*Studio Sound* February 1988) is now in production and a fully working model was demonstrated at the Hamburg AES. Based on the in-line mixing format the console provides 4-band parametric EQ, high and lowpass filters and two stereo aux sends. Each channel has its own status display for remaining headroom, overload and grouping and true digital 100-segment bargraph PPM meters are provided for all input channels and output buses. It is available in frame sizes of 16 inputs (up to four groups), 36/64 inputs (up to eight groups) and will accept all digital formats but these must be specified at the time of order.

• The **Numera/ABAC** digitally-controlled console is now in production and several pre-production units are already in use with FR3 television in France.

The production version of the console has a maximum capacity of 64 input channels with 48 multitrack buses and several control units (or 'mixers') can be networked to one set of audio racks, thus facilitating situations such as concert sound where house and monitor mixes are required from common sources. The audio racks can be remotely installed at 50 m from the control unit by cable or at 800 m with a fibre-optic link.

The console is completely automated with a maximum time length of 90 min. Data can be downloaded to a tape streamer in approx 4 min. The system can also be synchronised to SMPTE timecode.

The configuration of the console is user-programmable and setups can be stored and recalled as required. **Numera, 11 rue Primatice, 75013 Paris, France. Tel: (1) 45.87.17.56. Fax: (1) 45.35.79.95.**



Numera/ABAC digitally-controlled console.



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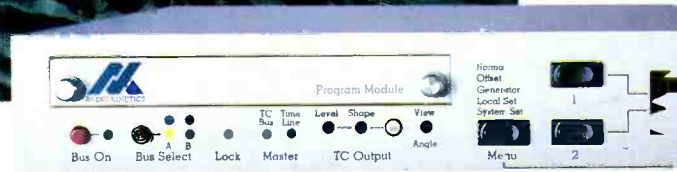
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(206)355-6000

## AKG CAP 340 M

The AKG CAP 340 M is a digital audio signal processor that finds applications for digital recording, acoustic simulation/design and psychoacoustical research.

The CAP 340 M consists of the processing unit, the host interface, the host computer (Hewlett-Packard) and the audio interface. The data format of the processing unit is 32 bit floating point providing a S/N ratio of 140 dB and is available with 20 to 340 MFLOPS of computing power. The audio interface contains the A/D converter with an incoming data format of 16+3 bit and sampling rate selectable from 50/48/44.1 kHz.

The 'blank slate' approach of the processor allows a wide range of possibilities: a digital mixing console with eight binaural input channels with level, elevation, pan, delay time and channel-on controls; a user-definable multiband equaliser with little or no phase shift; Angle Dependent Filtering (ADF) and Delay Time (DT), a program that compensates for the differences between a main stereo pair of

microphones (in any configuration) and spot microphones. Other stereo mix/placement configurations are also possible; acoustic design by room stimulation. A room can be drawn to given or ideal dimensions and treated as required while being fed with a sound source that is heard all the time. Both the source and the 'microphone' can be moved to any location within the room; psychoacoustical research such as listening tests, sound source localisation, timbre of sounds and filter design.

A full graphics display accompanies each function for greater clarity. **AKG Akustische U Kino-Geräte GmbH, Brunhildengasse 1, 1150 Vienna, Austria. Tel: (222) 95.65.17-0. Fax: (222) 92.34.58.** **UK: AKG Acoustics Ltd, Vienna Court, Catteshall Wharf, Catteshall Lane, Godalming, Surrey GU7 1JG. Tel: 04868 25702. Fax: 04868 28967.** **USA: AKG Acoustics Inc, 77 Selleck Street, Stamford, CT 06902. Tel: (203) 348-2121. Fax: (203) 324-1942.**

## Meyer MS-2/3 power amplifiers

Meyer Sound have introduced the MS-2/MS-3 power amplifiers featuring linear performance, very low distortion and hum, the ability to handle difficult and complex loads, the integration of Meyer Sound processor cards and a remote control interface. Other features include transformer-balanced inputs with ISO-input to eliminate earth (ground) loops, a minimum load impedance of 2  $\Omega$ /channel and switched input attenuators.

Power ratings are 300/600 W into 8  $\Omega$  respectively. Dimensions are 2U/3U for a behind panel depth of 17 $\frac{1}{2}$  inches. Weights are 57 lb and 72 lb.

**Meyer Sound Laboratories Inc, 2832 San Pablo Avenue, Berkeley, CA 94702, USA. Tel: (415) 486-1166. Fax: (415) 486-8356.** **UK: Autograph Sales Ltd, 2 Spring Place, London NW5 3BA. Tel: 01-485 3749. Fax: 01-485 0681.**

## Pearl microphones

Recently released are several new microphones: TL-4, MS2/8 and CC30.

The TL-4 studio microphone features a double membrane system with two amplifiers, rectangular membranes for even response and freedom from resonances and transformerless amplifiers with high output level (3.6 V maximum in stereo mode). It can be used in a variety of configurations including omnidirectional, figure-of-eight, twin or single cardioid, 180° stereo and true MS. Frequency response is 16 Hz to 20 kHz. A variety of accessories is available including the PDV-8 preamplifier/control unit for direct connection to the recorder.

The MS2/MS8 are stereo condenser

microphones, the MS2 with an MS matrix built into the microphone body. Both microphones produce mid and side signals and these are available in two formats: type K with an omni M(mid)-channel and type C with a cardioid M-channel.

The CC30 is a cardioid condenser mic with transformerless output, high output level and low noise floor. A very flat frequency response is assured by the use of a large rectangular membrane.

**Pearl Mikrolaboratorium AB, Box 98, S-26501 Astorp, Sweden. Tel: 042 588 10. Fax: +46 42 598 90.** **UK: Elliott Bros (Audio Systems) Ltd., Osney Mead, Oxford OX2 0ER. Tel: 0865 249259.**

## Midas XL Series

The Midas XL Series Two live performance console is now in production and already meeting with a good sales response.

The XL Two has been largely re-designed since Midas joined the Klark-Teknik group in order to make it more suitable for current production techniques and is now available in 40-/32-/24-input frame sizes. A 16-input extender frame is also produced.

The console features transformerless low noise input circuitry, 4-band EQ with parametric mid bands, channel gain metering, eight

subgroups with 2-way matrix, stereo master buses, eight auxiliary sends, eight mute groups and other familiar Midas facilities. The auxiliary and group buses can be reversed in order to configure the XL Two as a house or stage monitor console as required. **Midas/Klark-Teknik Research Ltd, Klark Industrial Park, Walter Nash Road, Kidderminster, Worcs DY11 7HJ, UK. Tel: 0562 741515. Fax: 0562 745371.**

**USA: Klark-Teknik Electronics Inc, 30B Banfi Plaza North, Farmingdale, NY 11735. Tel: (516) 249-3660. Fax: (516) 420-1863.**

## Amek Mozart

Amek have introduced the Mozart recording console, which is the result of two years research into the requirements of studios using SMPTE/MIDI-locked setups, re-triggering and tapeless recording. The design incorporates facilities that were developed for the APC console, together with new developments such as more in-depth automation.

The console is controlled from a central alpha-numeric keyboard with a tracker ball and is available in standard frame sizes of 40, 56 or 80 input channels. All frames include 12 stereo effects returns of which three have full multitrack routing. There are also four 'wild' VCA faders that can be assigned to returns as required for mixdown.

The Mozart is based around three main concepts: integral automation, all-input format channel modules and an increased number of auxiliary sends.

The automation forms an integral part of the console and the design for the fader and mixdown automation system has been developed in collaboration with Steinberg of Germany. A feature of the system is that it provides an extremely comprehensive cue list facility (for SMPTE/Audio/MIDI-triggered events) over and above the control of faders, mutes, groups, snapshots and VCA fader curves.

The console setup (switch setups, knob positions, etc) for a session can be stored into memory and this is known as a Page (or Master Console status). Up to 99 Pages can be stored and these can be loaded in sequence and called up as required manually or via external control through MIDI and RS-232 ports.

Due to the complicated control of the channel switching (15 per channel), special ICs known as

Applications Specific ICs were developed and two are used per channel.

The all-input channel module features four inputs—mic/line/bus/tape—together with a DI input which is similar to line but with a gain structure more suited to instruments. The EQ section is 4-band with parametric mid frequencies and increased boost and cut for the HF/LF sections.

The Mozart features 16 auxiliary sends, which are addressed from four mono and two stereo pots. Sends 7 and 8 also have an Alternate Input switch for the routing of an unselected input to the stereo or multitrack buses. All routing and auxiliary buses are balanced with 32 multitrack buses fitted as standard.

An additional feature is an in-line monitor channel module and both channel types can be used in the same frame for added flexibility. The in-line module is largely along the same lines as the all-input channel with the exception that sends 7 and 8 become the monitor section and that the EQ section can be split between the channel and monitor paths.

The console has also been designed with an eye to film/television post-production and the in-line module provides for 4-channel mixes (left/right:front/rear) by being able to convert the monitor panpot into front/rear pan. The pan centre is also dropped to -6 dB for better definition.

**Amek Systems and Controls Ltd, New Islington Mill, Regent Trading Estate, Oldfield Road, Salford M5 4SX, UK. Tel: 061-834 6747. Fax: 061-834 0593.**

**USA: Amek Consoles Inc, 10815 Burbank Boulevard, North Hollywood, CA 91601. Tel.: (818) 508-9788.**

## RTW digital mastering system

RTW have released the *1190 DMS* Digital Metering System for the Sony *PCM-3324/3324A* digital multitrack recorders.

The 3U meter assembly is housed in a tabletop enclosure and is meant to be installed at the mixing console. Connection to the *PCM-3324* is via a 50-way Sub-D connector installed at the rear of the chassis.

The digital input to the unit is SDIF format with the sampling rates between 39 and 56 kHz.

The system consists of 24 neon-plasma 201-segment bargraph displays with an attack time of one sampling rate period. Fall back time is adjustable from 0.5 to 2 s and various display modes of level and peak hold are available. Operating

modes include level with or without peak hold or peak memory and storage of peaks into memory.

Other features include adjustable overload indication from 1 to 15 samples and adjustable headroom in 2 dB steps from -20 to -6 dB. The display shows increased brightness within the headroom range and emphasis is indicated by a green LED below each channel display. The system is delivered with 24-channel metering, control module, power supply and cabinet. A remote control unit for the peak hold/memory functions is also included.

**RTW GmbH, Elbeallee 19, Postfach 710654, 5000 Köln 71, West Germany. Tel: (221) 70913-0. Fax: (221) 709 1332.**

## GML moving fader automation system

GML Inc has announced a new hardware and software version of the GML moving fader automation system. *Version 6.0* is designed to operate within the *Series 2000* Console Automation Environment adding intelligent master machine control, Ethernet networking capability, an optional graphics display and editing capabilities beyond current system facilities. GML say that this system continues their tradition of expanding functional software control into the latest available high speed technology. The computer package has been updated to include an internal 3½ inch disk drive for

transfer of data between the standard 40 Mbyte hard disk. It is possible to maintain 8 inch floppy capability through an external drive which is necessary if the system is to be capable of converting the 8 inch SSL and Necam mix data disks to GML automation data.

The GML *Version 5.xx* automation software and standard GML interface hardware is upwards compatible with the new version.

**GML Inc, 7821 Burnet Avenue, Van Nuys, CA 91405, USA. Tel: (818) 781-1022**  
**UK: Syco Systems Ltd, Kimberley Road, London NW6. Tel: 01-625 6070.**

## TAC Bullet

TAC's *Bullet* console can be used as a free-standing unit or 19 inch rackmount. It is fully modular and contains 10 mix/line channels with balanced inputs, four subgroups, main stereo mix buses and six auxiliary buses. Each channel features 4-band EQ with sweep mids, two mono auxiliary send level controls switchable across four buses and one stereo auxiliary with level and pan and 100 mm channel fader.

The subgroup and master modules feature four stereo returns and comprehensive monitoring and

talkback facilities, together with 15-segment LED meters. A separate meter is also provided for PFL.

An Audio-Follow-Video interface is in preparation and will be available later on in the year.

**Total Audio Concepts, Unit 17, Bar Lane Industrial Park, Bar Lane, Basford, Nottingham, NG6 0HU, UK. Tel: 0602 783306. Fax: 0602 785112.**

**USA: Amek Consoles Inc, 10815 Burbank Boulevard, North Hollywood, CA 91601. Tel: (818) 508-9788.**

## Shure Beta series

Shure have launched the first of two microphones in the *Beta* Series, the *Beta 57* and *58*. These mics follow on the traditions set by the *SM 57* and *58* respectively—Shure describe the *Beta 58* as having the low frequency warmth and 'guts' of the *SM58* but with the smoother presence rise and extended top of the *SM57* condenser mic. With the *Beta 57*, the bass and HF responses have been extended from the *SM57* together with a smoother, more gradual presence rise.

Both mics feature a supercardioid pattern that Shure say the mics maintain at all usable frequencies as well as increasing levels before feedback. The capsule uses Neodymium magnet for higher output levels and a humbucking coil arrangement to reduce external electrical interference. The shock isolation system has also been improved to reduce transmission of handling and stand noise. Both have the traditional rugged Shure steel



grille and these are available in either bright or matt chrome options. **Shure Brothers Inc, 222 Hartrey Avenue, Evanston, IL 60202-3696, USA.**

**UK: HW International, 3-5 Eden Grove, London N7 8EQ. Tel: 01-607 2717.**

## Nexo design package

Nexo have launched *NEXO CAD*, which is a computer-aided acoustic design software package designed to run on an IBM (or compatible) *PC-AT* computer and allows the user to construct 3-dimensional models of buildings and to assess the results of different speaker placements.

The system offers a fully interactive colour graphics environment with windows and mouse control and the program can calculate all the parameters needed for the design of sound system installations. The user can build up files with the characteristics of different speaker components and systems (eg the Nexo range) and compare the performance of different systems within a given building at

different locations.

The program enables various different parameters to be taken into consideration—budget, dispersion requirements, SPLs—and these can help speed up the process of making out tenders to prospective clients. A full range of acoustical criteria is also covered.

A demonstration disk is now available on request from Nexo. **Nexo Distribution, 154 Allee des Erables, ZAC de Paris Nord II, BP 50107, 95950 Roissy, Charles de Gaulle Cedex, France. Tel: (1) 48.63.23.01. Fax: (1) 48.63.24.61.**  
**UK: Farrah's, Unit 7, St Georges Industrial Estate, Richmond Road, Ham, Surrey KT2 5BQ. Tel: 01-549 1787.**

## In brief

• **Sennheiser** have added two new microphones to their *MKH* series, the *MKH 60* and *MKH 70*. These units are long and medium reach rifle microphones with a very flat frequency response from 50 Hz to 20 kHz and low side colouration. Both microphones feature bass roll-off and presence-boost switches and -10 dB pad. A full range of accessories such as pistol-grip, windshield, 48 V power supply is also available.

• The **Saje Memory** software console is now in production with five

consoles having been delivered in France, one to Germany (Bochum Theatre) and five to Sweden. There are also serious offers from places as far afield as Japan.

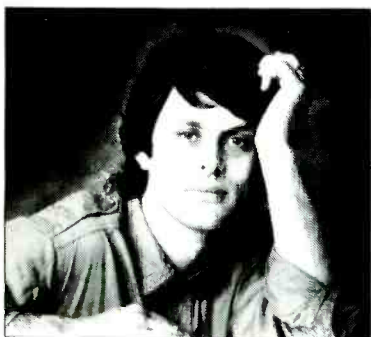
The *Live* software enables the console to be configured as required and put into memory for subsequent recall, thus greatly improving the ergonomics and efficiency of live sound situations such as theatre, on-air broadcast, concert sound, etc.

Detailed documentation is also now available in all the major European languages.



# On cue for the ultimate performance

Ask busy, professional Sound Engineers what they regard as the weak link in the audio chain and the answer will be NAB Cartridges. In all its years of use, little has changed. However, at last there is a viable alternative – the Ferrograph 9500 Digital Cartridge Recorder. Here's what Andrew Bruce has to say about it:



Andrew Bruce  
Sound Designer – "Les Miserables"



“The launch of Ferrograph 9500 came at exactly the right time for us. In 1987 I was looking to replace the broadcast cartridge machines that we used on "Les Miserables" in London because their inherent noise and lack of dynamic range was no longer acceptable.

The problem of reproducing realistic battle effects and, worst of all, single gun shots at high level in an otherwise hushed auditorium had become a matter of acute embarrassment for me – eight shows a week.

At first glance there seemed to be any number of digital machines available to choose from – but price or operating procedures discounted all of them with the exception of the 9500.

The direct "look alike" compatibility with the old format and its guaranteed instant start (and I mean instant) made it the only real choice for me and engineers who had to use it.

Consequently it has now become specified as standard equipment on all current and future versions of "Les Miserables" world wide.”

## FERROGRAPH

Ferrograph Limited, Mountjoy Research Centre, University of Durham, Stockton Road, Durham DH1 3SW.  
Telephone: (091) 386 8846. Telex: 537227 NEFERO. Fax: (091) 386 1727.

The round the world round of round table meetings between the IFPI and Japanese electronics companies continues. They were started, by Jan Timmer of Philips (ex-Polygram), with the aim of hammering out an acceptable format for DAT. As the only format acceptable to the IFPI was a digital recorder that didn't record digitally, it is not surprising that two years after the first meeting in Vancouver, in December 1986, there was still no agreement. But there is now a stronger will to talk.

This is not the result of some newfound love between the record and electronics industries. The will to talk and compromise is born out of sheer necessity. Delays on DAT killed the format for domestic use, making recordable CD a viable alternative. The record companies see CD-R as an even greater threat than DAT. The electronics companies see CD-R as a new money-spinner, provided that they can agree a technical standard that appeases the record companies.

At Philips' Annual General Meeting in Eindhoven earlier this year Jan Timmer was still confident that the warring factions would eventually make peace.

"The software and hardware industries are still talking," said Timmer. "There is no conclusion yet but I think there is a better understanding by the hardware industry of the need to reach agreement with the software industry. I believe we will reconcile the two. Many manufacturers have announced erasable or recordable discs. There is no technical problem here. But there is need to set a worldwide standard, we need agreement on the technology. It will be a long time before we talk about the orderly introduction of recordable CD."

Later Philips engineers explained the need for a technical standard—even though all the different CD-R systems produce the same end result, a standard size CD with a spiral of marks that look to the readout laser like the pits in a pressed disc.

Some kind of procedure will have to be agreed for creating the Table of Contents at the beginning of the disc, so that the player electronics know what recordings are there to play. This is not as easy as it sounds, when you bear in mind that domestic CD-R will be used to build up a piecemeal compilation of favourite dubs from a variety of pressed CDs.

If the user makes a false start while dubbing onto a record-once disc, the TOC will have to flag the player to ignore that part of the disc. And this will eat playing time out of the total hour—rather like erasing records from EPROM computer memory. The erased records cannot be read but they remain in memory, soaking up capacity.

Says Gijs Wirtz, the man responsible for DAT at Philips:

"We have forever lost the freedom of the '50s and '60s. In those days you could construct your own radio set from components. The consumer electronics industry can no longer just put a product on the market and see what happens. But obviously we can't make a recorder which cannot

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Barry Fox

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## Recordable CD systems and an electronic music technology course

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make recordings. We are working on a compromise."

Wirtz draws an interesting parallel:

"In many respects digital recorders are like a telecommunication network—they both allow digital cloning. Once information has been sent down a digital telecoms network, it is there for anyone to copy as many times as they like. So users pay for the service. The telecoms industry was fortunate that governments understood the problems and made rules that are backed up by law, for instance to prevent phone tapping. The consumer electronics industry has so far lacked similar structured standardisation of hardware and software, backed by Government enforcement."

Magneto-optical erasable, or rewriteable, discs are already made, eg by 3M, for the computer industry. They are expensive and difficult to read on a conventional CD player, because the reflective character of the disc is below the standard set by the Red Book.

Canon has developed the rewriteable optical drive being used in the Steve Jobs Next computer. This relies on interesting new technology to skirt the current compromise between life and readability. Conventional rewriteable discs use a layer of rare earth which slightly changes the polarisation of reflected light when magnetised. Materials which give a large phase change, and are thus easily read, have short life. Their switched magnetic state changes too easily. More stable materials switch the phase by only 0.1°.

The Canon disc has *two* rare earth layers, one with low coercivity, but high Curie point, on top of another layer with high coercivity and low Curie point. The top layer gives a strong phase shift, and its short life magnetic state is continually backed up by the long life layer underneath.

So far Canon are supplying discs and drives only to Next, ready for deliveries to begin in June in the USA. Canon say they aim to offer an optical system which beats hard disk for price and performance within two years. Current OEM prices are around \$1,500 for the drive and \$50 per disk.

Tandy is still pledged to make the *Thor* erasable CD system available this year, for around \$500. *Thor* uses a double layer of dyed plastics, and two lasers, of different wavelength, for write and erase. The top layer passes the write beam so that it can heat the lower layer and cause bumps. The top layer bumps then absorb the erase beam. So they melt and flatten,

erasing the recording. The snag is that the bumps never completely flatten. So the disc has a good SN ratio when first used to record, but the ratio degrades steeply on first erasure and then degrades slowly on subsequent record/erase cycles.

Other manufacturers have opted for cheaper systems which record only once. They argue that 60% of audio cassette tapes sold are never re-used, so the public will be happy with a one-use disc.

Taiyo Yuden has promised That's CD. Philips engineers have tried some of the discs which Taiyo were touting round Europe and found that the technology used does not tally with the description given by Taiyo. The disc does not record by gas explosions caused in the surface layer by heat from the laser; instead a dye layer is bleached by the laser. No-one yet knows how stable the dyes will be. Doubtless this is why Taiyo says the disc must be kept clear of bright sunlight.

At the giant CeBIT computer show in Hanover earlier this year, Fuji demonstrated a write-once recordable CD, which works with a recorder made by Yamaha. Fuji proved, with demonstrations, that its disc is directly compatible with a conventional CD player and can be handled just like an ordinary CD, without the need for a protective cartridge.

There have been two more roundtable meetings since the Philips AGM—and they are still no closer to a real solution.

This could be interesting. The University of East Anglia, Norwich, UK, is running a residential course this summer (August 26th to 30th) on electronic music technology. For around £300 you get your hands on a roomful of keyboards, guitar, drum and wind controllers, tone generators, samplers, computers, digital MIDI mixers and recorders with tuition from the likes of Dave Mattacks, Adrian Lee and David Bristow.

Yamaha is providing the hardware—around 25 work stations for a hundred pupils. Maybe it's an act of contrition, for flooding high street shops, homes and bars with play-in-a-day keyboards complete with chords and rhythm accompaniment programmed in Tokyo.

The UEA are aiming the course at semi-pros who already own a few pieces of electronic kit, at professional musicians who have so far played only acoustic instruments and at broadcast and studio engineers who want to plug some holes in their knowledge. As UEA say, "No-one knows everything."

With such a mixed bag of pupils, there will obviously have to be some careful streaming, to ensure that students aren't paying £300 to learn to 'suck eggs'. And hopefully there won't be too much musical philosophising from academics.

With a bit of luck the cost of the course, called *Soundscape*, could be money well spent for anyone now trapped by job circumstances into pretending that they know more about electronic music than they really do.

Details from *Soundscape* at UEA. Tel: 0603 592802. □





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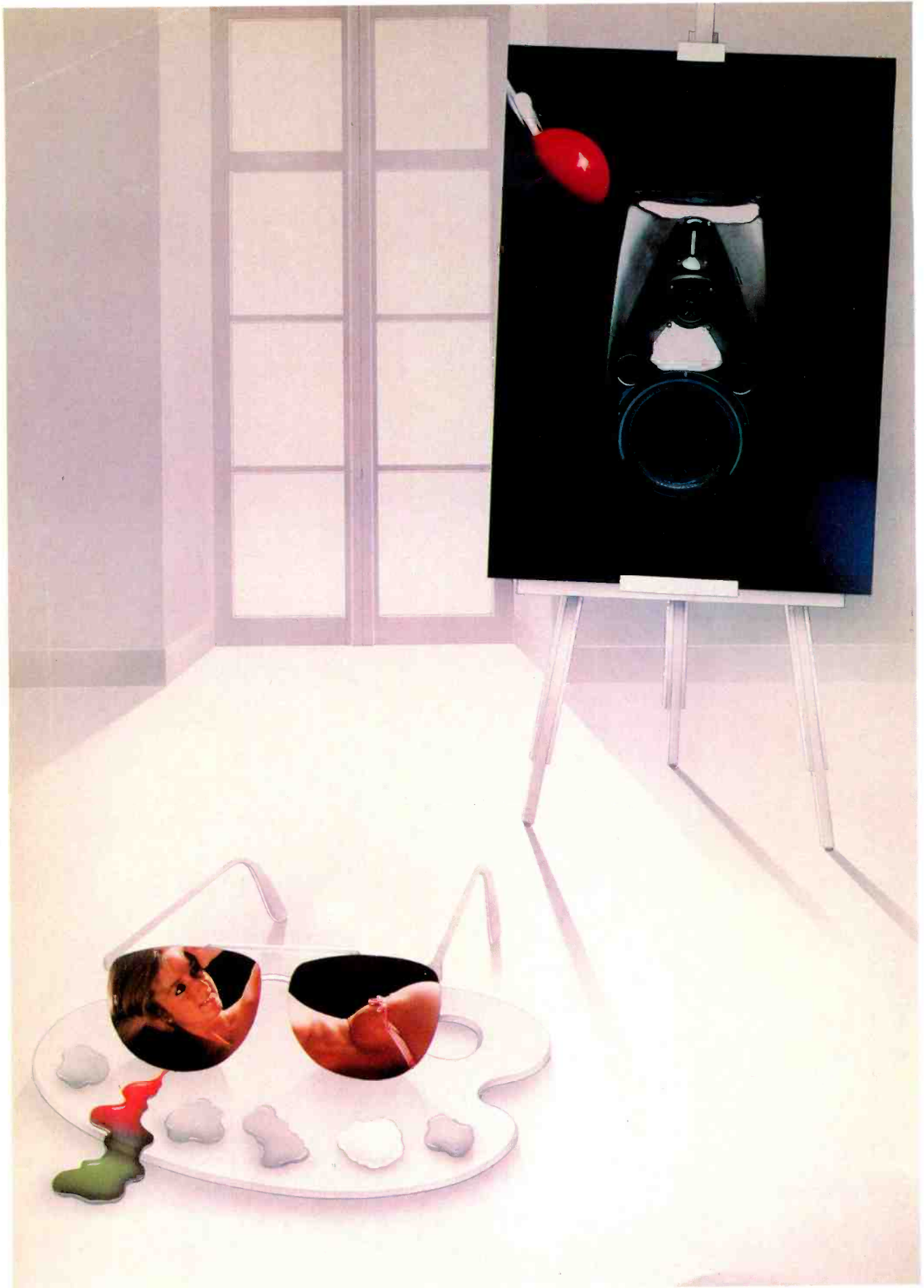
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Spring '89

# Solid State Logic

# Real World Shapes The Future

(See Page 2)



Le Studio, Montreal. One of many studios installing G Series.  
(See Page 3)



Also Inside:

ScreenSound

New Production Unit

SL6000 G Series

SSL Milan Office

# Real World Shapes The Future

Peter Gabriel's residential studio complex, Real World Studios, in Box near the Georgian city of Bath, has opened with what is one of the most spectacular studio control rooms so far constructed. Appropriately, it is also the home of one of the most impressive and novel SSL consoles so far supplied.

The vast control room/recording area houses a huge, U-shaped, custom built SL 4000 G Series console. The SL 4080 console is fitted with 64 channels, G Series Studio Computer with Total Recall™ and an SSL Synchroniser Control system. The console includes ample frame space for the addition of extra channel modules. Special features include film panning, tape transport remotes panel, custom centre section meter panel, a synchroniser and status display panel, plus custom patchrows and producer's table. The console also houses unique custom Cue Matrix circuitry designed by Real World technical staff.

While the console breaks new ground, its positioning within the room is also novel. The console faces away from the recording area and looks through large windows over a man-made lake and mill race, which partially surround the converted Box Mill building.

The unusual nature of the complex extends to the other recording areas too. Throughout the converted Bath stone building are naturally lit areas with stone walls, raised catwalks and special ceramic air conditioning ducting. Almost every room in the residential studio complex is available as a recording area and these are all linked with mic, line and MIDI tielines to the studio's three control rooms.

The two other control rooms are owner Peter Gabriel's workroom and a keyboard/programming room. Both of these are also equipped with SSL Consoles: an SL 4048 E Series with 36 channels, G Series Studio Computer and Total Recall™; and an SL 4040 E Series with 40 channels and an SSL Studio Computer.

## First G Series Down Under

Sydney's Rhinoceros Recordings has rapidly established itself as one of the world's best recording facilities since its inception in 1981. With the installation of an SL 4072 G Series with 56 mono and 4 stereo channels and G Series Computer with Total Recall™ in its new Studio 2, Rhinoceros has certainly joined the top rank of prestigious international studios.

Studio owners, David Nicholas and Andrew Scott, have always believed in using the best studio designers and equipment in their goal of gaining an international reputation for Rhinoceros. When they came to specify equipment for their new studio, they were immediately attracted by the extra speed and improved software of the G Series computer and the sonically improved audio performance of the G Series console. In choosing G Series for their new control room they expected the best—and they weren't disappointed, as Michael Fronzek, Technical Director of Rhinoceros says, "The G Series console and computer address the few shortcomings of the E Series, which has already established itself as the Rolls-Royce of recording consoles."



▲ Studio 2, Rhinoceros Recordings, Sydney



▲ Los Angeles Record Plant

## Fifth SSL For Record Plant

The Los Angeles Record Plant, part of the Chrysalis Group and one of the world's leading recording facilities, has installed a new SL 4000 G Series console. Record Plant's new console is an SL 4072 with 64 channels, G Series Studio Computer and Total Recall™. Located in Studio 2 of Record Plant's recording complex, the console is used for record dates as well as for scoring of television and motion pictures.

"We've had great success with SSL consoles since 1979," says Chris Stone, President of Record Plant. "This is our fifth SSL console and it replaces a previous E Series model that has been in service for seven years—longer than any other console in the history of the studio. The new G Series offers significant advances in clarity and range of control and once again SSL has established a new standard for quality in console technology. Our clients are among the most demanding in the world and the initial reactions have been absolutely incredible."

## SL 6000 Goes G

The SL 6000 E Series Stereo Video System for music, video and teleproduction applications has been upgraded to full G Series performance specification. The new SL 6000 G Series is now in production and the first system has been supplied to Post Logic, Hollywood.

The SL 6000 G Series retains all the key features of the E Series, namely its three stereo mix busses and main stereo programme bus. It also retains its ability to provide extensive audio processing, routing and mixing flexibility with machine synchroniser and events control.

G Series features which have been added to the system include, sonically improved EQ, mic and line amps, Group amps and Monitoring sections. The G Series EQ and Input cards are also available for retrofitting to E Series consoles.

The incorporation of the G Series Studio Computer system brings to the SL 6000 the advantages of faster processing, vastly increased on-board memory and the use of high capacity Disk Cartridges for data storage. In addition, the system incorporates the G Series software package which includes new features such as selective rollback, immediate pickup of fader, comparison of mixes on-line and a host of preview functions.



▲ Centre section of the new SL 6000 G Series

The new, wider centre section incorporates a full sized QWERTY keyboard with numeric keypad and function keys, plus the new SSL Split Cues system which allows the output sends of the right- and left-hand sides of the console to be separated.

Post Logic in Hollywood purchased their first SL 6000 system three years ago. Miles Christensen, the Director of the facility, was so impressed by the SL 4000 G Series music recording console system, that when he came to equip Post Logic's new six room facility, he placed the first order for an SL 6000 G Series system.

The Post Logic console is an SL 6064 G Series with 52 mono and 4 stereo channels, G Series Studio Computer with Total Recall™, and features all the G Series sonic improvements. The console also includes several customised options to enable it to be used for single, two or three man operation. This allows the console to cater for a wide range of applications, from simple track-laying and premixing to dubbing sophisticated shows.

With over 150 SL 6000 E Series Stereo Video Systems already in operation with recording, broadcast and post-production facilities throughout the world, it is anticipated that the introduction of the advanced SL 6000 G Series will further extend its use for stereo broadcast transmission, production and post-production.

## G Series Worldwide Sales

More major studios throughout the world are installing SL 4000 G Series consoles.

In North America these include, The Hit Factory, The Power Station and Cole Studios in New York; Larrabee Sound, Aire LA and Blue Canyon in Los Angeles; plus Tarpan Studios of San Rafael for Narada Michael Walden, Little Mountain Studios of Vancouver and Le Studio, Montreal have also installed G Series.

Over 25 Far Eastern clients have now either installed or ordered G Series consoles. Foremost among new SSL clients in the Far East is Tokyou Bunka Mura Studios, Tokyo, which has ordered three identical SL 4064 G Series consoles for its newly created recording studio complex.



▲ SL 4072 G Series in Studio 203 JVC Aoyama Tokyo

Also ordering G Series in the Far East are, JVC Aoyama Studios, Tokyo; Music Inn Studios, Tokyo; Yamaha Epicurus Studio, Tokyo; Take One Studios, Tokyo and Platinum Studios Taiwan. All of these are multiple SSL console users - this is JVC Aoyama's ninth SL 4000 console!



▲ SL 4064 G Series with custom effect wings at Nomis, London

G Series orders by new Far Eastern clients include: Somewhere Studios, Toshiba-EMI, Hakutobo Studios and Zero Studios (all in Tokyo), plus the Tokyo Photo School.

Twenty SL 4000 G Series consoles have been supplied in Europe to, among others, Le Studio, Brussels; Wisseloord Studios, Hilversum; Excalibur Studios, Milan; Arco Studios, Munich; Studio N, Cologne; Studio Marcadet and Studio Davout in Paris; plus The Church, Metropolis and Nomis Studios in London.

# New Production Unit Opens

**L**ate September saw the completion of the new SSL production unit at the company's Oxford headquarters. This purpose designed building is now fully operational and accommodates the latest in high-tech manufacturing and testing facilities.

The new building is a lightweight 2-storey unit with a total floor area of 3,800m<sup>2</sup>. It uses the very latest techniques in building service technology and includes automatic, electronically controlled shading systems to create a pleasant and productive internal environment. The structure, which has already attracted considerable interest within the architectural community, has a square plan with a central



top-lit atrium. The building features full height tinted glass external walls to give a light and airy working environment.

While the structure reflects the breaking down of the distinction between conventional factory and office space, the design allows the internal layout to be highly flexible. The interior can be rapidly re-configured, as it features demountable glazed and solid partitioning, with a grid network of power, data and communications distribution feeds. This allows the internal layout of the unit to be altered to suit changing production and office space requirements. This is an important consideration as the company's development programme takes us into an extended product range and ever more advanced manufacturing techniques.

SSL has a tradition of commissioning highly individual, yet practical

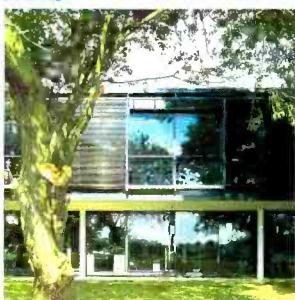
building designs. The former headquarters building at Stonefield, with its distinctive similarity to a parish church, is a notable example which also gained praise from architects. The new building continues this innovative tradition. Indeed, the new Michael Hopkins designed production unit has already featured in the internationally respected magazine *The Architects Journal*, where a 17 page article was published in the October 1988 edition.

THE ARCHITECTS' JOURNAL

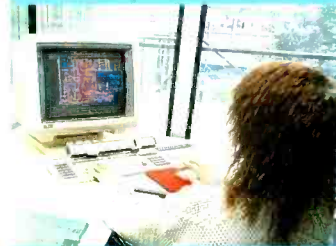
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**AJ**

**RIBA PREPARES TO BITE THE BUDGET  
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▲ Central atrium of the new production unit, providing natural light to console frame wiring on ground floor.



▲ Computer Aided Design.



▲ PCB Department.



▲ Cable Assembly.



▲ Frame Wiring.



▲ Console Frames.



▲ Console Test Cubicles.

# Unit Will Further Improve Standards



The new unit replaces three separate buildings housing production facilities which were located in the nearby town of Witney. Hence, SSL now has its administration, sales, marketing and final production facilities located together at its Begbroke headquarters. The only exception to this centralisation of facilities is the pre-production sub-components facility which remains at Brandon in Suffolk. This separate facility has strong links with the local community and has a dedicated workforce with a long experience of building console sub-assemblies.



Adjacent to the production unit is the former convent school (converted from a typical English stone-built country house), which houses the accounting, sales, marketing, training and service departments. An annexe contains a fully equipped test-bed studio and listening room.

## Layout of the Production Unit

The lower floor of the new building accommodates a central stores area; console frame wiring, test and acceptance areas; and a final load and trim area. The central stores feature computerised stock control systems and computer controlled component carousels. Test includes automated soak test and fault finding computer controlled systems, which speedily identify any sub-standard boards or components. Accordingly, problems are immediately identified and corrected, and boards are retested prior to final quality control approval. Similar principles apply to Final Test where console assembly is carried out and complete systems undergo testing and acceptance by commissioning engineers. Separate test cubicles ranged around the perimeter of the building provide facilities for individual system testing.

The upper floor surrounds the central atrium and houses a mixture of offices and production areas. Specialist areas include SSL's Computer Aided Design department and a fully equipped workshop. Both are located close by the Design Information Services and Research and Development departments

The Production departments include hardware and assembly, wire looming and the pcb department.

Also located on this floor are the production management offices and the purchasing and shipping departments.

Thus all departments and personnel involved in the development and production of SSL systems are grouped together.

"A great deal of thought has gone into the design and construction of our new production unit," says SSL Chairman, Colin Sanders, CBE. "The flexibility of the design means that we can tailor the internal layout to our manufacturing priorities as they evolve in the future. The advanced facilities ensure that we are equipped to meet the needs of all our existing and future production requirements. Our new building is neither a factory nor an office, but a highly functional

structure with an attractive working environment. Its completion, and the centralisation of all our main facilities at our Begbroke headquarters, enables us to further improve our efficiency and production standards."



▲ Wire Looming.



▲ Automated Test.



▲ PCB Automated Test.



▲ Production departments surround the central atrium.

# Digital Audio for Video and Film

Unveiled in prototype form at last year's NAB Convention in Las Vegas, our ScreenSound digital audio-for-video editing suite is currently undergoing final pre-production testing and development. Release of production systems is scheduled for summer of this year.

ScreenSound is the result of technological co-operation between Solid State Logic and sister company in the UEI Group—Quantel.

The system is a fully integrated audio-for-vision editing suite offering digital audio editing, mixing and recording for off-line video and film post-production and audio-for-video editing applications. Using an intuitive pen and tablet control surface and a monitor display to access a wide array of functions for the laying up of soundtracks, ScreenSound offers unprecedented control of the audio post-production process.

The system incorporates all the functions necessary for edit and review, time offset, track slipping, cross fading, and the recording and manipulation of sound clips. These features are combined with the inherent advantages of recording, editing and copying in the digital domain.

The system is available in either NTSC or PAL configurations, with comprehensive digital and analogue input/output interfaces.

ScreenSound comprises a rack unit housing the processor, hard disk storage and interface hardware, and a separate rack containing a WORM optical disk sound effects library store and an 8mm tape drive

archival storage device which stores sound clip and edit data.

A tablet and pen and full size QWERTY keyboard provide the operational interface. System menus and functions are displayed on a standard RGB monitor, with visual images being monitored on a separate screen.

When linked to Quantel's Harry Suite in the HarrySound mode, both video editing and the laying up of the soundtrack can be performed simultaneously, within the same operating structure and using a single monitor screen.

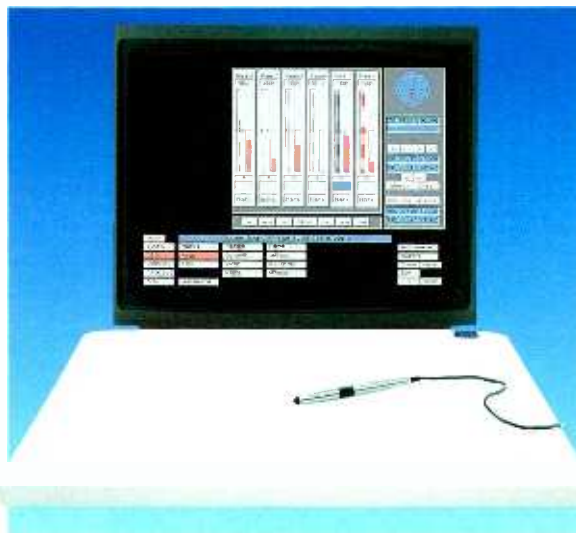
The system can also be used off-line from an adjacent suite using a second tablet and pen.

At demonstrations of systems around the world, ScreenSound has received unanimous acclaim from both engineers and the press. The simplicity of its pen and tablet control interface and the innovative nature of its integration of audio manipulation for the video and film post-production environment has been particularly praised.

Since the preview demonstrations of the system, considerable development of the system software has taken place. Feedback from audio-post engineers has assisted in the development of enhanced screen displays and

functions. Machine control systems have also been added.

ScreenSound now incorporates full VTR/VCR and film reproducer machine control and machine level interface with Quantel's Harry Suite for operation in the HarrySound mode.



▲ Main ScreenSound display with tablet and pen.

## 01 Set for Delivery

First release of the 01 Digital Production Centre. SSL's integrated digital mastering system, is set for the middle of the year.

Delivery will commence during June and July of systems ordered by clients in the UK, France, Belgium, Japan and the USA.

Public demonstrations of pre-production units will take place at the NAB Convention, Las Vegas, with full production commencing shortly after.

At presentations given to over 500 recording studio, broadcast, video and film engineers throughout the world, the 01 has proved highly popular. The system's simplicity of operation and familiar console control surface have been especially praised. Its ability to perform complex digital mixing and editing processes has also received an enthusiastic response.

The 01 is a totally integrated stereo mastering system. It comprises an edit suite, 8 channel mixer with extensive digital signal processing (including digital EQ and dynamics sections) and a hard disk store offering two hours of stereo audio. The system's back-up recorder for archiving and storing all takes and edit information uses an 8mm tape drive system fed from a SCSI port.

The 01 can serve as a digital master or multi-part recorder, support complex multitrack recording and mixdown sessions and be utilised for stereo programme mastering, production and post-production applications.

The system provides high quality digital audio and maintains digital integrity through the stages of signal processing, editing and sequencing.



▲ 01 operating in conjunction with an SL 4000 G Series.



# Disney Installs SSL's Largest Console

The new Disney-MGM Studios complex at Walt Disney World, Lake Buena Vista, Florida has installed the largest Solid State Logic audio console so far constructed, in a new dubbing theatre at Disney-MGM's post-production facility.

The console, Disney's second SSL desk, is an SL 56124 M Series Film Post-Production system with 96 channels, G Series Studio Computer with Total Recall™ and Instant Reset™, Moving Fader automation and LCD metering. It has three operator positions and is configured for film and video dubbing, audio production and audio sweetening for television programmes.

The console, which is operated by the Post Group for Disney-MGM Studios,

is suitable for simultaneous mixing of music, dialogue and effects, or for single-operator audio sweetening of videotaped programmes.

Following installation, the console has been used on a number of television series and sitcoms.

"We are proud to offer the new SSL audio console as part of our world-class post production capabilities," says Ted Kaye, Vice President of Film and Tape for the Walt Disney Company. "The Disney-MGM Studios have been designed to provide producers with superior facilities and equipment, operated by the finest creative talent in the industry. This new audio console is a significant addition to our production complex."



▲ Disney-MGM's SL 56124 M Series console undergoing installation and commissioning.

# SSL Film Post-Production Network Expands

The international community of SSL film system users continues to expand rapidly. Joining the ranks of prestigious users such as Lucasfilm, Todd-AO, Disney and Mosfilm, are numerous European and North American clients.

Foremost amongst new purchasers of film systems are Pinewood Studios in the UK. Pinewood, renowned throughout the world for the calibre of its film soundtracks and its many Oscar awards and nominations, has ordered an SL 5496 M Series

system with 60 channels, three operator positions, G Series studio computer with Instant Reset™, and joystick film panning.

Other major film system purchasers include IDH Sound in Los Angeles—an SL 55100 M Series system with 72 channels and G Series Studio Computer with Total Recall™ and Instant Reset™.

A further large film system, an SL 5592 M Series with 72 channels, G Series Studio Computer with Total Recall™ and Instant Reset™ and Moving

Fader automation system is to go to SIS Studios in Paris.

Auditel, Paris has ordered an SL 5680 with 56 channels, G Series Studio Computer with Total Recall™ and Instant Reset™ and Moving Fader automation system.

Finally, Bavaria Film, Munich has chosen an

SL 5536 with 24 channels, G Series Studio Computer with Instant Reset™ and Moving Faders.



▲ Personnel from Mosfilm, Moscow, acceptance testing at SSL.

# Post-Production Sales Boom

As the demand for high quality screen audio continues to grow, SSL has received unprecedented demand for its broadcast and post-production systems. Within the last six months SSL has supplied over 20 systems to clients and a further 10 systems are currently on order from broadcasters and facilities houses around the world.

In Japan DVC, Tokyo has ordered an SL 4032 G Series, Videowork Studio, Tokyo has ordered an SL 4032 G Series, and Prosen, Tokyo has ordered an SL 4040 G Series.

In North America, Fox Television, Los Angeles has ordered an SL 5448 M Series with 24 channel multitrack return, 4 mono and 4 stereo channels plus Instant Reset™ and G Series Studio Computer. The Canadian Broadcasting Corporation in Toronto has placed an order for the second SL 6000

G Series to be supplied. This is an SL 6048 G Series with 40 channels.

In Europe the BBC has ordered an SL 4056 G Series for its Maida Vale studios, whilst Swiss Television, Zurich has ordered an SL 5656 M Series for their Studio 2. This console will join two SL 5000 M Series systems previously supplied for Studios 1 and 4.

Videotime, Milan, has ordered four identical SL 5444 M Series.

On delivery, Videotime's Studios 4, 5, and 7, plus their OB vehicle, will be identically equipped.

Of particular note is that these orders are spread across several different SSL systems.

With the SL 4000 G Series, SL 5000 M Series and SL 6000 G Series, 'post' clients have an unrivalled choice of console systems from SSL to satisfy their requirements.



▼ Cinair Studios, Montreal, one of the many recent SSL post-production system installations.

# Expansion of US Operations

Due to the continuing success of SSL in North America, with over 25 systems supplied in the last six months, an expansion of the administration, sales and service facilities has been undertaken.

Heading the expanded US Operations is Piers Plaskitt who has been appointed Chief Executive of Solid Stage Logic Inc. Piers was formerly Vice President of SSL Inc. and has overseen the Eastern Sales and Service operation in New York since 1984. In his new role, he takes overall charge of the company's US operations and oversees the establishment of a central US administration based at the East Coast office.

"SSL has seen a number of milestones in North American sales since I joined the company in 1983," says Piers. "Following our move from Washington DC to New York City in 1984, over 200 systems have been supplied to US clients. With the development of our administrative capabilities we are equipped to provide even better sales and service support."

Alongside the development of the New York office, SSL's West Coast office in Los Angeles has undergone a major expansion of its facilities. An additional 1,500 sq. ft. of space for office, stores and demonstration studio use has been provided.

"When we established the SSL Los Angeles office in 1984, we had a staff of three and around a dozen West Coast clients," comments Andy Wild, Vice President of Western Operations. "Now we have a sales and service team of 10 and over 70 consoles to support."



▲ New demonstration studio at SSL's Los Angeles office.

"To reinforce our commitment to West Coast clients we have expanded our facilities. We now have a larger service area with a comprehensive stock of basic components and board spares. We have also added a 500 sq. ft. demonstration studio with an SL 4000 G Series console, multitrack audio machine and video machines. This studio allows us to hold in-house training sessions for up to 20 engineers. In addition, we also use the studio to carry out research and development work especially attuned to the needs of our North American clients."

# Focus on Milan

The SSL sales and service operation in Milan, Italy, is now well established under the direction of Sales Manager, Claudio Belletti, who reports a high level of interest in SSL products. Recent contracts from Italy include SL 4000 G Series systems for Excalibur Studios, New Clan Studios and Splash Studios, plus four SL 5000 M Series systems for Italian post-production house, Videotime.

Established in January 1988, the Milan office is the most recent addition to SSL's network of subsidiary companies. "We have had a successful inaugural year," says Claudio, "and the future looks good too. We have received enquiries from facilities throughout Italy, with interest being shown in all our systems. These include post-production, outside broadcast and film projects, as well as more music recording studio projects."

Claudio was appointed Sales Manager of SSL Milan in January 1988 and brings a wealth of experience of the Italian pro-audio industry to the company. He has a background as a professional

musician and audio consultant and prior to joining SSL operated his own 24 track music recording studio, Chroma Studios.

SSL Milan's Technical Services Manager, Giovanni Blasi, has many years service experience, not only in Italy, but also in the UK and West Germany. Having worked with several professional audio equipment suppliers and distributors, Giovanni has specialist knowledge of advanced systems including synchronisers and digital equipment. Whilst with Hotline Studios, Frankfurt, he was responsible for maintaining one of the earliest SL 4000 systems.

Executive Secretary, Paula Lodesani, has recently joined the company and is in charge of administration. Paula has widespread business experience with several major industrial companies, including appointments with companies in New Zealand, Singapore and Malaysia.

For further information on SSL Sales and Service in Italy, telephone Milan (2) 612 17 20.



▲ Claudio Belletti (right) and Giovanni Blasi in the Milan offices of SSL.

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# Lotsa Questions...

## CD

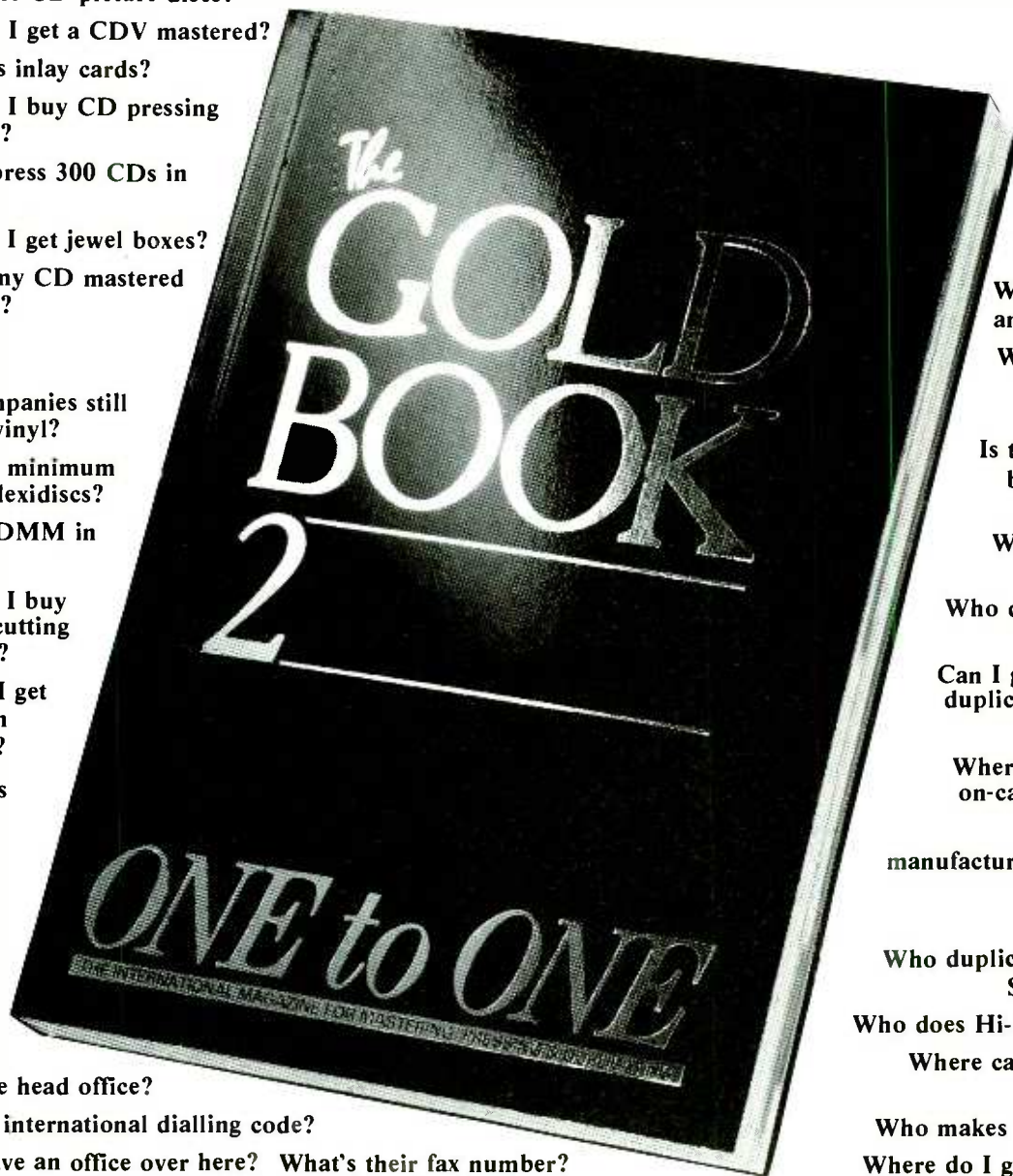
- Who presses CD picture discs?
- Where can I get a CDV mastered?
- Who prints inlay cards?
- Where can I buy CD pressing equipment?
- Who will press 300 CDs in Europe?
- Where can I get jewel boxes?
- Can I get my CD mastered in Georgia?

## VINYL

- Which companies still press 10" vinyl?
- What's the minimum order for flexidiscs?
- Who cuts DMM in London?
- Where can I buy used disc cutting equipment?
- Where do I get stampers in New York?
- Who makes lacquers?
- Where do I get green vinyl records?

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- Where's the head office?
- What's the international dialling code?
- Do they have an office over here? What's their fax number?
- Have they got telex?



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- Who does labels and inlay cards?
- Where can I get DAT tapes duplicated?
- Is there a cassette box supplier in Israel?
- Who makes tape pancakes?
- Who duplicates data cassettes?
- Can I get metal tapes duplicated in central London?
- Where can I buy an on-cassette printer?
- Is there a C-0 manufacturer in Caracas?

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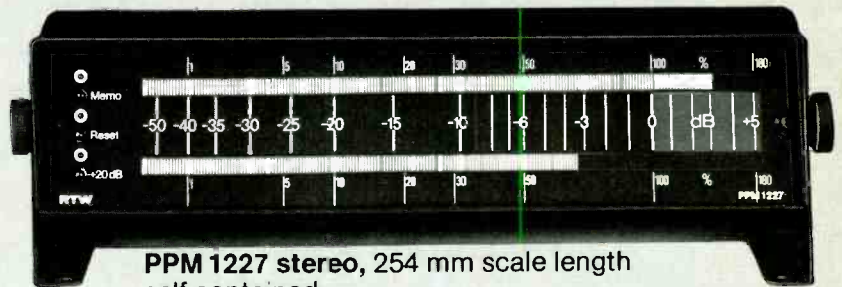
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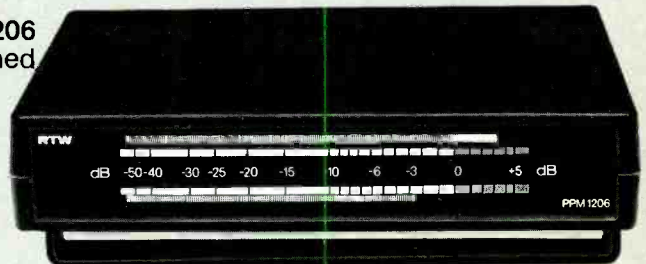
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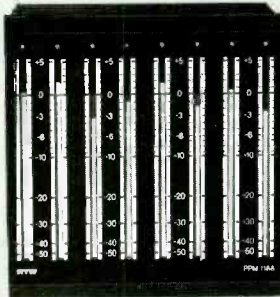
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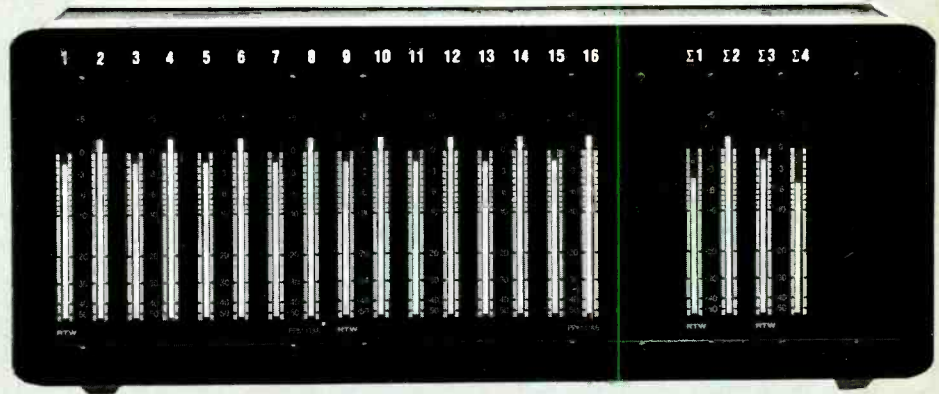
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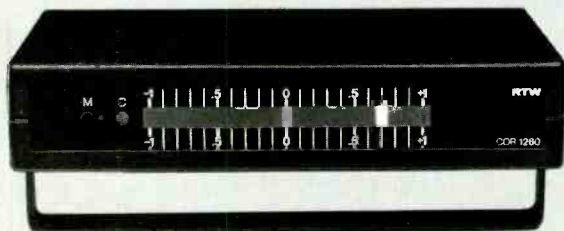
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# AES HAMBURG

## A REVIEW OF PAPERS AND WORKSHOPS

The AES papers and workshops, as usual, included the interesting and uninteresting presentation, the understandable and the highly technical. Some added to their pre-prints, bringing their subjects to life. Others read blandly from their papers, not even leaving time for questions to enliven the proceedings. In trying to multiplex myself between one workshop room and two simultaneous sets of papers, it was highly irritating to return in time for an interesting subject to find no empty seats and even the doorway full of seven foot tall Deutschlanders. Please AES, since we are going to have papers, let's have enough room to sit down if we are dashing in and out as our interest leads us.

**Incorruptible Digit:** Shake a fibre optic cable and irritate your favourite studio or broadcaster. Did you know that by vibrating the digital transmission link you can introduce analogue distortion by shifting the unshakeable digit? According to Toshiharu Kuwaoka of Victor Company of Japan (*AES Preprint 2763*), jitter and reflections in the digital transmission link can mess up those idealised D/A converters, even those with 18 bits and 100 dB of dynamic range.

Other garbage is introduced by earth and power supply glitches, just like in analogue gear. These are produced during the process of reconstructing the digital data from its CD or DAT encoded format. In the conversion ICs, large numbers of internal states can change at once, drawing or dumping large amounts of noise onto the rails. Kuwaoka's measurements show noise and distortion increases of up to 10 dB due to these effects. The solution offered is to decouple the digital processing and A/D sections by an opto-coupler, use separate power supplies, and regenerate an accurate timing signal to eliminate jitter.

**CD Mastering—Pitfalls for the unwary:** CD mastering would appear simpler than with the old LP in many ways, having a greater tolerance to out of phase L and R components, and wider dynamic range. But, even after six years of CD production, mastering rooms still get unusable material, or generate errors themselves. All this is exacerbated by the CD practice of not producing a test pressing. Thus final responsibility often rests with the mastering facility rather than the disc manufacturer or recording studio.

Many of the problems originate from the wide variety of input formats received. In the bad old days of black vinyl discs, it was usually 1/2-track, 1/4 inch stereo at 15 in/s. Maybe CCIR equalised, maybe NAB. Anything else became obvious quickly. Now there are more tape formats including in excess of 22 digital variants, multiple noise reduction systems, and several sampling rates. The message—use a suitable format for input and write on the box what it is!

Another hidden problem is introduced by some inexpensive D/A converter systems which are multiplexed between L and R outputs. This can induce an 11 µs difference between channels, resulting in stereo image shift.

Once the input material is correct, other problems begin. These have to do with the PQ

codes which carry the track and index information, along with certain other control codes on the final CD. For example, on a boxed set of CDs it is officially impossible to begin the second CD with a track number other than 1. Other potential errors are the incorrect setting of the emphasis bit, or the accidental setting of the CD-ROM bit causing muting of the CD player on detection. Sony and other makers of CD mastering systems, 'Help!' Put some checking software on your mastering system if you haven't already.

Thank you Reiner Oppelland of Bauer Tonstudios, you have obviously been through it all (*AES preprint 2805*).

**Right on—Lousy Off:** Rhonda Wilson at the University of Sydney has been experimenting with loudspeakers. First she measured an unequalised loudspeaker both on- and off-axis. Then, using a digital equaliser, she set things up to get a near perfect on-axis response. Surprise, surprise, the off-axis response got worse. In the end, the equaliser was set to flatten a weighted combination of both on- and off-axis results. Now we await the results of her listening tests to decide how on- and off-axis responses (over multiple angles) affect what we want to hear.

The results of these experiments will probably

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Did you know that by vibrating the digital transmission link you can introduce analogue distortion by shifting the unshakeable digit?

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become available in a loudspeaker with a built-in digital active crossover/equaliser one day, but can you imagine the local hire company measuring their system on-axis and at 15, 30, 45, etc? And then there's the room; it all makes work for the working consultant to do.

**Zipper Up:** Did someone in the room just adjust their zipper, or was I imagining it? Digital was going to be so wonderful. Spreadbury and Lidbetter from Neve have discovered a trail of problems which will make semi-conductor manufacturers' mouths water. Zipper noise from faders, and panpots, and aux sends and—if I zip slowly enough and carefully enough maybe no-one will notice. But how slow is slow? Maybe I won't get it up before it needs to come down again. To make the right decision, perhaps a microcontroller or a DSP chip per fader would help. Drool TI, drool.

What about switching? Flip a switch fast and it clicks if a signal is going through it. Flip slower and it will be silent—almost. (Don't try this with the master switch on your fuse box unless you fancy fireworks night.) With analogue this is relatively easy. With digital there are lots of numbers to crunch. Toshiba, are you listening?

What happens to a digital filter if you vary it in realtime with a signal present? Lots more calculations are needed if the result is to be good, otherwise temporary filter insanity will appear.



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It seems easy enough, but sampling to never let it appear at the output we have output clipping, and answer again? Check it. Crunch,

numbers for lunch.

There is more of this, but you need to buy the book to get the whole story (*AES preprint 2807*). **Rate Reductions and the Community Charge:** Seriously now, there were several papers dealing with ways of reducing the data rate for digital audio transmission, hinting at digital broadcast with more channels. Audio data rates down to 64 kbits/s were mentioned while still offering improvements on current FM quality standards. Not too many years ago there were lots of papers on encoding and error correction schemes. Now we have CD and DAT. Keep your eyes open, this work is not being done for nothing. Perhaps real community radio will ride on the back of digital radio transmissions. You can bet that the manufacturers working on these systems hope to replace all our existing radio and television sets, or at least the RF sections of them.

**Which Window?:** By now everyone must have heard of *TEF*, the magical solution to measuring acoustics and loudspeakers. Well, while you can see a lot using *TEF* that you couldn't see before, some of it doesn't really exist, so interpretation is critical. Stanley Lipshitz (whose presentation was music to my ears) looked at one area of existing confusion, the use of windows.

These windows are not the same as those on your favourite computer, they are designed to minimise errors in mathematical processes which assume infinity in their theory, but in reality

start and stop in realtime or at real frequencies. The FFT, used to get useful data on frequency response and the like, assumes that you sample the data at regular intervals from  $-\infty$  to  $+\infty$  in time. If you do this boring activity, then you get perfection in the calculated result. Since only God was around at time zero or is likely to exist at time infinity, in reality we always get some error. An FFT calculation effectively wraps the data you

## While DAT is proven to provide a recording quality limited only by the converters used, its freedom from errors over time and multiple playbacks are not well known

are using back on itself, connecting the signal at the start time to the data at the end time. If there is a mis-match at the connection point, spurious data results, just like the click of a switch when signal is on it. Those of you trying to loop samples will have an idea of what I mean.

In *TEF*, the window problem is a little different, but closely related. Using a window can improve the results but the wrong type of window can introduce more error than it removes. That has been happening a lot in the use of *TEF*, but without the user realising what he has been doing. The recommended window for audio (at this moment) is the  $\frac{1}{2}$  Hann window. Preprints are available direct from Professor Lipshitz at the University of Waterloo, Ontario, Canada.

Wolfgang Ahnert of the Cultural Institute in Berlin has compared *TEF* and impulse response measurements (both taken properly) and found good correlation between the results. *Preprint 2812* gives details of the tests compared.

**Is DAT Professional?:** Two considerations in using any recording format in a professional environment are its durability and shelf-life. While DAT is proven to provide a recording quality limited only by the converters used, its freedom from errors over time and multiple playbacks are not well known.

Siegbert Herla of the Radio Institute in Munich has been investigating the durability, and found it to vary both with tape type and machine type. Using five samples of one tape type, he measured error corrections/min, interpolations (the first step when errors cannot be corrected) and mutings (dire straits). All tapes produced mutings by the time 100 playbacks had taken place, some in less than 40 playbacks. His conclusion is that DAT should not be used in repeated playback applications like jingles at this stage in its development. He recommends a professional DAT recording format using a higher tape speed and wider track for professional use. (*Preprint 2769*). It would be interesting to see a comparative paper on the reliability of DASH, DAT and analogue recording media.

**M for MIDI:** Thomas Finfern from Hamburg presented a paper proposing the creation of a computing language *M* to be used with the MIDI hardware standard. Being a programmer in the *C* language, he is proposing a similarly structured language which 'understands music'.

While most users would not want to control their equipment by classical computer programming methods, it does seem useful to

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further define the data formats used by control software so that virtually all of the data produced by one program can be read and manipulated by another, and compatible macro-instructions to enable easier batch processing. Not being a vast MIDI user, it is difficult for me to comment intelligently on this. The AES was challenged to get involved in a standardisation programme.

**Safe Studio 'Earing Levels:** In one of the invited papers, Wolfgang Kraak of the Technical University of Dresden summarised his 25 years of investigation of the individual risk of hearing damage due to noise. TTS (Temporary Threshold Shift) can be measured under controlled exposure to high level noise. This is a measure of the change in sensitivity of the ear at the threshold of hearing, before and after exposure to the noise. The amount of TTS and the recovery time back to normal hearing correlates very well with individual sensitivity to PTS (Permanent Threshold Shift) or hearing loss. Thus it should be possible in a few hours to screen people for the relative danger they face from high level noise. Of course, this is not going to help the few for whom TTS does not reveal the risk. Details can be found in *AES Preprint 2794* except for the table below, which was given during the lecture.

Professor Kraak recommends the following exposure limits for professional audio exposure:

Susceptibility:		Hrs/Year
Average	More Sensitive	of Exposure
85 dBA	75 dBA	<1600 hrs (40 man-wks)
90 dBA	80 dBA	<1000 hrs (25 man-wks)
95 dBA	85 dBA	< 500 hrs (12.5 man-wks)
100 dBA	90 dBA	< 280 hrs (7 man-wks)

**XY v MS Stereo Microphone Techniques:** Manfred Hibbing of Sennheiser has investigated the relative merits and weaknesses of these two

## The problem is to check the assumptions of the designers and the truth or fiction of the results

recording techniques in terms of theoretical and practical performance. XY involves aiming two identical mics at an angle to the main sound source—the crossed pair technique. MS uses a figure-of-eight response looking sideways plus a forward facing mic usually of cardioid or omni characteristic. He concludes that though these are theoretically equivalent, the MS works better because of the on-axis use of the M mic, and the superior off-axis characteristics of the S mic. Important though is that the two mics match in their frequency response characteristics, and that these are smooth.

## Workshops

Among workshops, those on Digital Broadcast, Assignable Mixer User Interfaces and Sound System CAD were of most interest to me. The first is the subject of another article, showing the differences in national culture and their effect on planning digital broadcast.

On mixer user interfaces, there was a clash of the conservative British view of fader per channel, with a frankly outlandish proposal where buttons and faders changed their purpose from moment to moment. The latter was described afterwards by the representative of one British company as 'out to lunch'. To counter this, there

were at the show mixers using the basic principles of each type. The British companies lean toward VCA or moving faders with one per channel. At the other extreme, ABAC Rustin from France showed a console with a set of belt driven faders, which provided only an operational window into a larger console. Guess who has sold more assignable mixers, and it isn't a British company. Sometimes 'off-the-wall' ideas are worth considering to collect the ideas which can be honed to usefulness—don't forget DeBono's lateral thinking exercises.

Regarding sound system acoustic CAD, there are exciting developments on the way. Unfortunately it is difficult to describe the facilities available on any one system, even by the manufacturers themselves. Systems from PHD, Bose, Nexo, ANT and JBL were described and now include 3-D room display, SPL maps, ray tracing, time arrival statistics and more. The problem is to check the assumptions of the designers and the truth or fiction of the results. There is now a standard 3-D description of loudspeaker polar performance but the curves supplied by one well known manufacturer are too good to be true. For system designers like me, reality is important but in the commercial world it has been a long time since honesty prevailed.

## Summary

The papers also covered technical aspects of loudspeaker design, microphone applications, digital signal processing techniques and other matters. A call to the AES will bring you a full list of preprints from which you can select those of interest to you. □

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control of two tape machines, position display in both bar/beat and time code, Tempo Map learning and editing, and MIDI merging.

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The last count the number of different recording/editing systems using hard disks as the working medium (as opposed to tape) stood at 28, although we suspect another one or two are being developed under wraps. These range from stereo to multitrack, from minutes to hours of storage, from mainframe to PC-based systems, with price tags varying from 4- to 6-figure.

Admittedly, some of these systems have yet to become commercially available, and it would be fair to say that a number of the functions claimed by manufacturers are only a twinkle in their designers' eyes. However, with the combined worldwide sales of those systems which are available reaching over 300, hard disk recording can no longer be regarded as an eccentric hobby for the rich. Additionally, those who have purchased systems have now had time to expose the teething problems and have passed on very useful feedback to the manufacturers. Systems have developed accordingly and with this in mind, together with the expanding features and widening price range, it is probably an

compatibility (a 16-track tape can be played on many different multitrack machines), but it has sonic disadvantages such as hiss, dropout, wear and crosstalk. Domestic media such as cassette or vinyl record introduce further limitations. The master may be relatively noise free, but the disc cutting process is regarded as fairly crude and can introduce noise and bandwidth restrictions. Cassette tape also suffers from bandwidth restrictions as well as tape dropout. Both media are also susceptible to wear.

With digital recording the audio is first converted into discrete binary numbers (called samples) which are obtained by taking a sample of the source analogue signal at predetermined intervals (called the sample rate). The higher the sample rate the better the approximation of the original signal (recordings made for compact disc take a sample 44,100 times a second). The advantage of using binary numbers is that a value can be represented by 1s and 0s. A 1 can be represented by a voltage (or anything above a certain level) and 0 represented by no voltage (or anything below a certain level). Small noise

## Random access

Since computers also deal with binary numbers, digital audio lends itself to be readily computer controlled. This opens a new dimension for processing audio allowing powerful editing, and effects such as reverb, time compression and more. However, in order to take advantage of computer control, the audio must be stored on a medium which allows accurate and fast access to any part of the recording.

With tape, one way of knowing where you are, apart from aurally, is by looking at the counter. This has the disadvantage of being independent of the tape; if you accidentally run off the end of a spool the counter will no longer refer to the same places it did before. A more reliable method of reference is to record timecode onto one of the tape's tracks. The disadvantages of this are you use a track which could otherwise be used for audio, it requires external synchronisation equipment, can suffer from dropout and bleed into adjacent audio tracks.

Disk-based systems on the other hand, use the

# PRACTICAL HARD DISK PART ONE

There are now at least 28 hard disk recording/editing systems of varying types. In this article Yasmin Hashmi and Stella Plumbridge draw together some of the practical aspects common to the technology

formatting process to physically record a position reference throughout the disk so that any position on the disk can be precisely located. In general a disk only has to be formatted once (and this is usually done at the factory). Every sample recorded onto a disk will have its own unique position reference (or address) and these addresses can be given labels such as '1st verse' or 'Middle 8' or 'Nasty bit where the vocal goes all over the place'. So if you've found the start and end of the first verse in the recording and have told the computer to label this section '1st verse', it will take those start and end addresses and store them with the label. Thereafter, irrespective of where you are in the song, if you tell the system to play the '1st verse' it will find the corresponding start address on the disk and play from there to the end address. The time it takes to locate the address is almost instantaneous, whereas the time it takes for tape to do this can be tens of seconds. Consider the examples shown in **Figs 1 to 3** in comparison.

Let us consider that we are using a disk-based system to mark out further salient positions in a song we have just recorded. Listen through the whole song and stop at the end. Label this as 'End of song'. Then tell the system to copy the '1st verse' and place it immediately after the 'End of song'. This should take very little time and, depending on the system, may involve simply moving a dial or clicking with a mouse a couple of times. Now tell the system to play the new arrangement.

To you it appears that some audio (in the form of the 1st verse) has been added to the end of the song, but in fact the disk head is simply flying around the original material and throwing it out when, and as often as, you told it to. When the system gets to the 'End of the Song' label it sees a command to play the 1st verse again. It knows the address of the 1st verse so it jumps straight back and plays the 1st verse again, see **Fig 4**.

It follows then, that if you have sectioned up your original recording with labels, you can play the sections in any order you wish, totally reshuffling the order in a matter of seconds. So ▶

appropriate time to review some of the basic facts.

Hard disk systems are guilty of adding another layer of jargon to the already crowded language of the audio industry, and the issues concerning their application are in some instances being made unnecessarily complicated. It is the aim of this two part article to uncover the jargon and provide background knowledge and points to consider when assessing a hard disk system. The first part looks at the main features of hard disk as a recording medium, along with some fundamental differences between tape and disk recording and editing. Storage time, track limitations, compatibility and back-up are often cited as disadvantages when considering hard disk systems. Part two of this article will discuss these and other issues as points any purchaser should consider with respect to their particular requirements.

## Digital sound quality

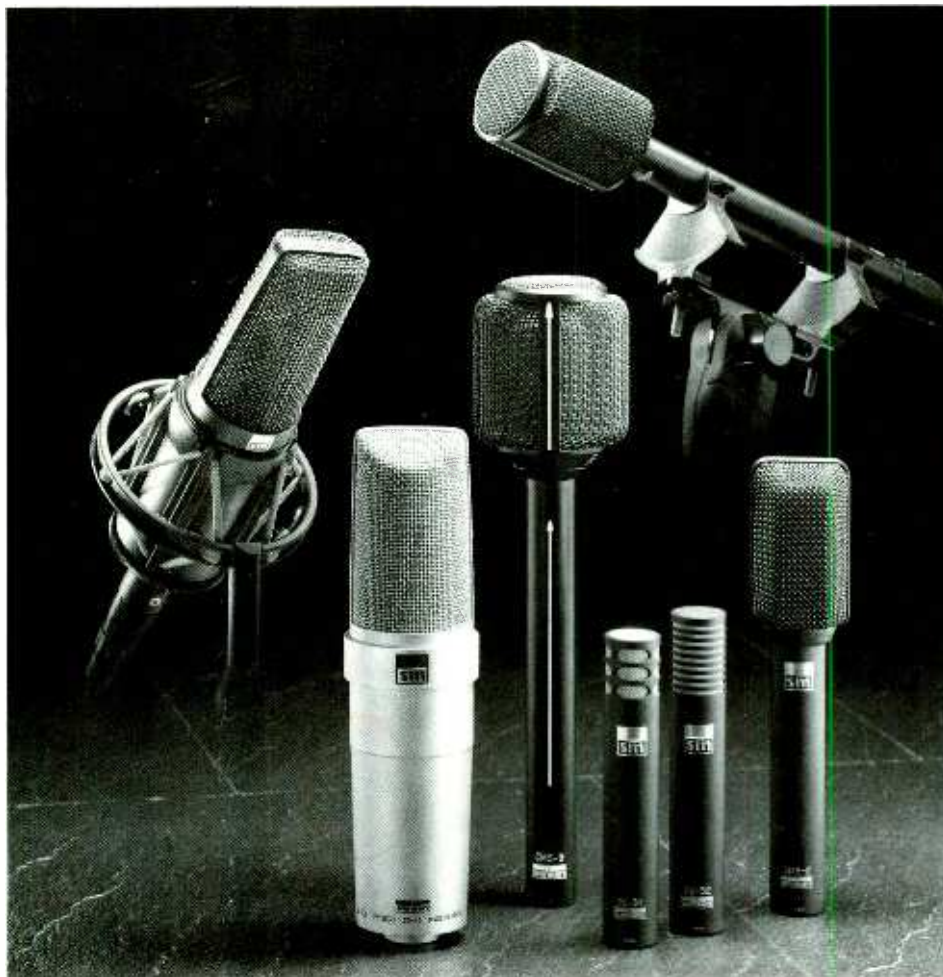
With analogue recording the audio is recorded and mixed in the form of continuously changing signals which can be affected by other (usually smaller) signals generated in and around the circuitry through which the audio must pass. In other words, analogue recordings are susceptible to unwanted noise; copying or bouncing tracks down, for example, adds successively more noise. As the storage medium for analogue recordings tape has advantages in recording time and

signals are therefore unlikely to turn a 1 into a 0 and vice versa, so digitised audio is virtually unaffected by noise. Digital audio can be stored on digital tape, hard disk, optical disk or RAM. Compact disc is the only medium available on a large scale for domestic digital audio reproduction. It has the advantage that in theory it should not suffer from wear and should reproduce audio with the same quality as the master.

To date, other digital storage media cannot meet the capabilities offered by hard disks for recording/editing bulk audio. RAM is not a practical medium for mass audio storage due to the capacity and availability of memory chips. Optical disks are high in capacity, but are currently too slow to write to and are mainly non-erasable. Digital tape does provide high capacity and realtime recording, but does not provide random access and can still suffer from tape dropout and wear. (It is, however, generally acknowledged that the difference digitisation makes to the elimination of noise in recordings is advantageous even when using tape.)

Hard disks do not suffer from wear since the samples are stored magnetically on disk and the drive head never touches the disk but rests just above the surface. Although they can suffer from dropout, areas on disk which are unsuitable for recording data are identified in the formatting process which tells the system not to use them. Hard disks provide quick access times (random access for recording/playback and also offer high enough capacity for mass storage of audio.

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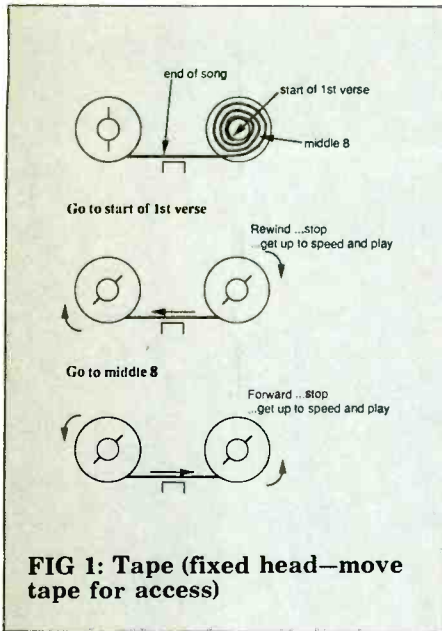
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◁ the question "What if we swapped the 1st and 2nd verses with each other?" is no longer a major headache, and takes as little time as using a keyboard or cursor to change the order in which the respective labels are played. Another example



which could take advantage of random access is when the chorus of a song is always the same. It is only necessary to record one chorus, label it, and then sequence the label as many times as the chorus is required.

Although the head of a hard disk drive may take virtually no time to move from one place to another, there are cases where the small amount of time taken can be critical, and can introduce undesirable delays. To avoid this problem, the audio can first be loaded into a buffer memory or RAM before being output. If the system knows the addresses it will be required to play in advance, the head can find the required audio and preload the buffer RAM, from which it is played in a continuous stream. There will be no intermittent delays because the head will be back filling the RAM continuously. The only delay would be right at the beginning of the PLAY command when the head is first filling the RAM. Fig 5 shows an analogy between buffer RAM being filled from disk and a barrel being filled by a bucket.

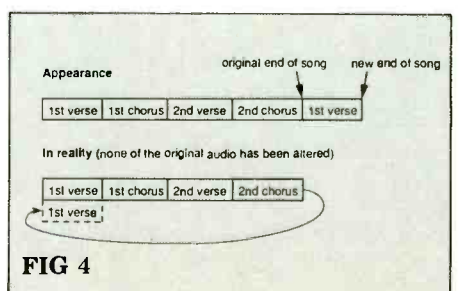
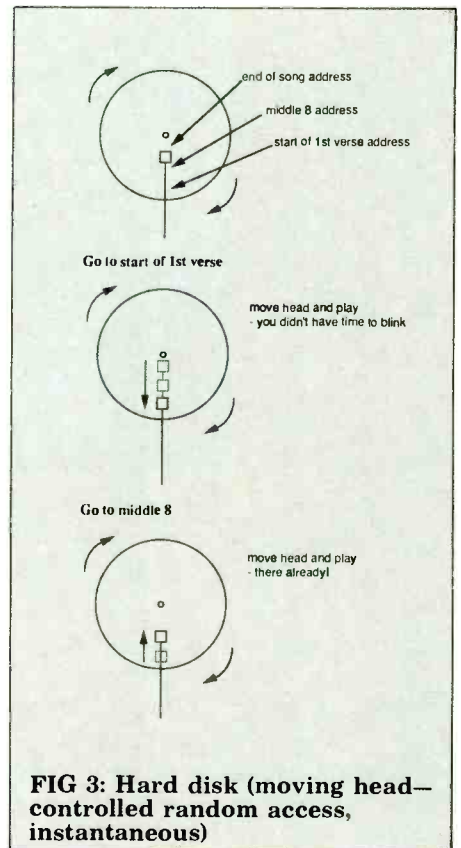
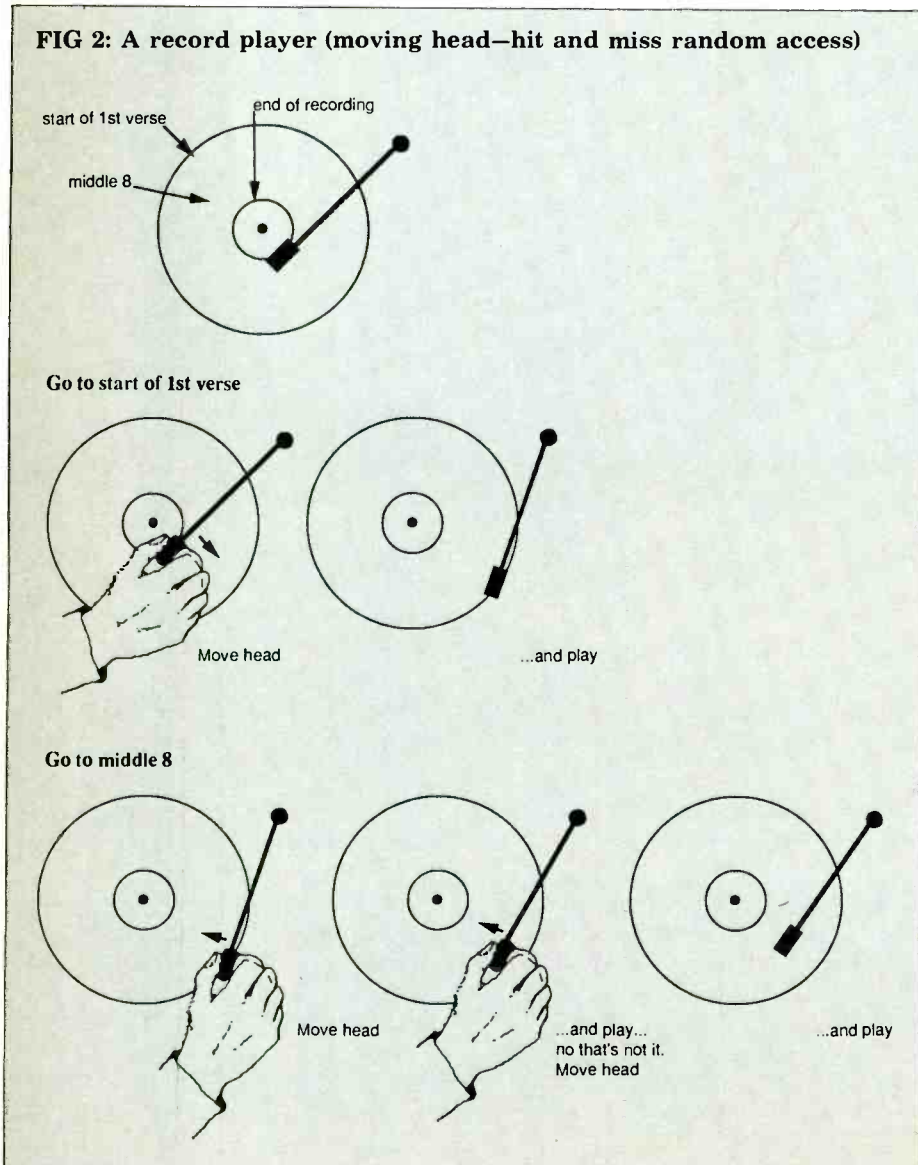
## Non-destructive editing

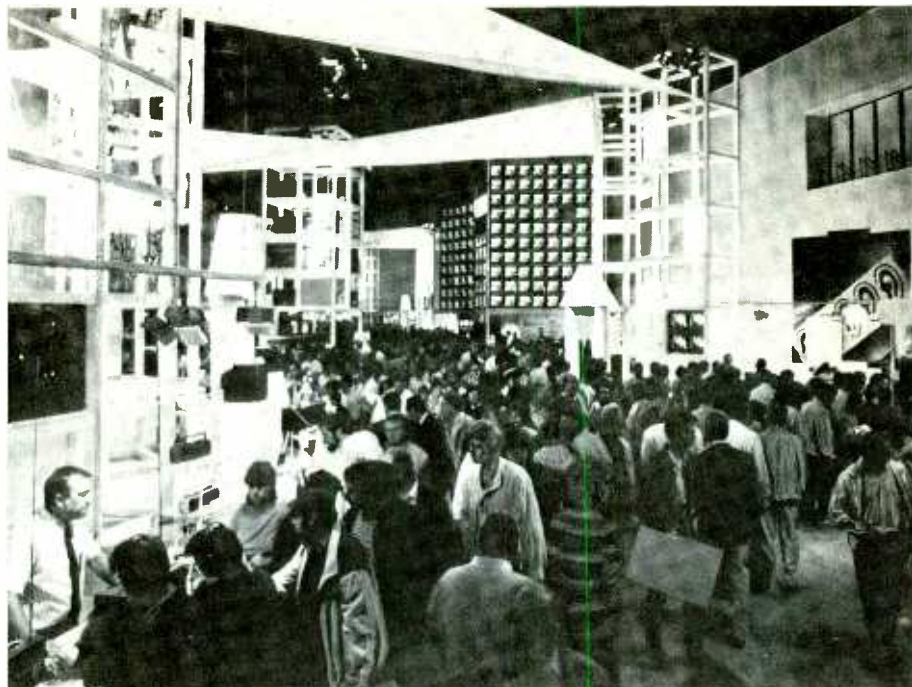
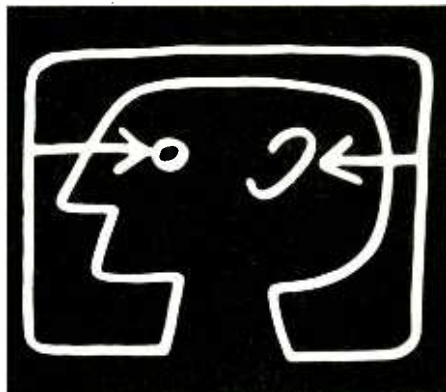
If you are familiar with word-processors, tapeless audio editors can be used in the same way. A computer is ignorant of whether it is being a

word-processor or an audio editor—it is simply dealing with numbers which could equally be text or audio or even video. The thing which makes the computer appear to be either a word-processor or an audio editor is the software written for it. This determines how your data is displayed, which editing functions you are provided with and how easy it is to use them. A word-processor, for example, can delete a word in a paragraph and reshuffle the rest of the words so that the gaping hole left disappears. An audio editor can do the same with sound. As with copying, erasing and pasting do not actually involve physically altering the original recorded audio.

Consider the example illustrated in Fig 6. Label where the 2nd verse begins and ends. Now tell the system to play the whole song except the 2nd verse. To you it appears that the 2nd verse has been erased, but what in fact happens is that when the system reaches the address of the 2nd verse it knows it must immediately skip to the address after the end of the 2nd verse. So if you change your mind and want the 2nd verse back in, don't worry, it's still there; just remove the command which tells the system to skip over it.

Compare this with tape editing where wrongly erasing the 2nd verse can be catastrophic or playing the 1st verse at the end of the song requires recording it onto another tape machine or sampler and spinning it in at the end. Also, if the position of the 'spun-in' 1st verse was slightly ▷





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head finding audio from different locations on disk and filling the RAM

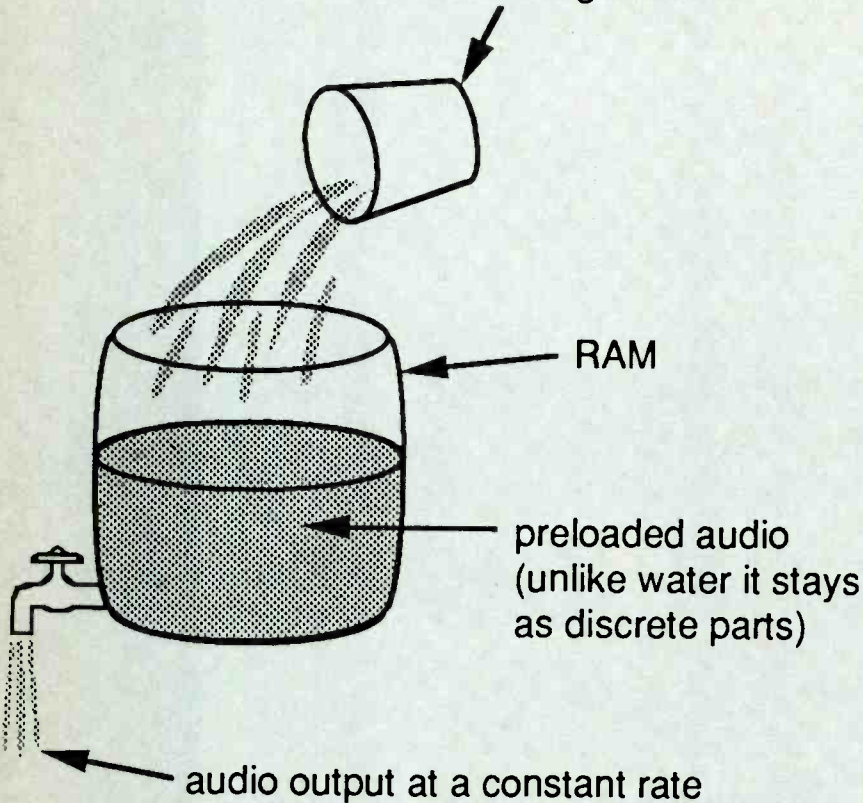


FIG 5

early or late the whole process would have to be repeated. With disk, the system simply needs to be told to play the 1st verse with a delay of whatever amount is required, as shown in Fig 7.

## Random allocation

It follows that if audio can be played in any sequence from any location on disk there is no reason why the audio should be recorded in a linear fashion in the first place. This concept is in direct contrast to tape recording. Since tape does not have random access, audio must be recorded in the physical order and time (directly proportional to tape length) in which it is to be replayed. For example, if there is a minute's worth of silence between two sections of audio, there must be a minute's worth of tape between them. Disk based systems can be used to record in this linear way yet still take advantage of random access, or they can flout the convention altogether. Consider the comparison shown in Fig 8.

The disk system need not record the silences in order to space the sections of audio the correct distances apart. External sync information can be stored along with the audio and can be used to automatically place the audio correctly on playback. As with Fig 7, the system will simply wait the required time before playing the next section of audio.

However, not all disk based systems allow total random allocation. This is obviously a point to investigate when assessing a system and is discussed further in Part 2 of this article.

## Archiving

What to do with the audio once the disks are full and new material is to be recorded is a problem. Hard disks are not removable so the audio must be offloaded onto another medium for archiving. This is where tape re-enters the scene as this is universally used for archiving audio from 'tapeless systems' (a few systems claim to use optical WORM drives for back-up—discussed further in Part 2). The tape used however, is not usually multitrack tape, but rather high speed tape, video 8 or some other suitable for recording digital data, yet realistic in size and cost. The time it takes to offload from disk to tape or vice versa, varies from system to system. Some are faster than real time, some slower, but the majority take around real time.

Appearance

1st verse 1st chorus 2nd chorus

In reality (again, none of the original audio has been altered)

1st verse 1st chorus 2nd verse 2nd chorus

skip

FIG 6

Appearance

1st verse 1st chorus 2nd verse 2nd chorus 1st verse

1/2 beat

In reality

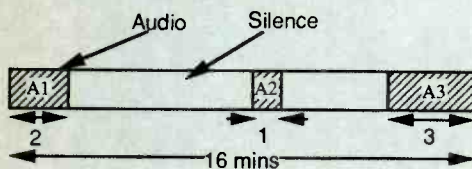
1st verse 1st chorus 2nd verse 2nd chorus

1st verse

waits 1/2 beat

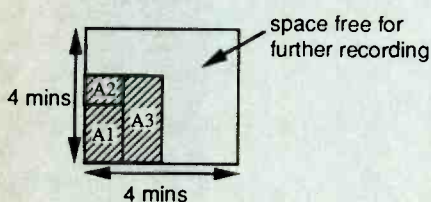
FIG 7

Tape (mono recording)



Available recording time = 16 mins  
Actual audio = 6 mins  
Total tape used = 16 mins  
Waste of space = 10 mins

Disk Analogy (mono recording)



Available recording time = 16 mins  
Actual audio = 6 mins  
Total disk used = 6 mins  
Waste of space = 0 mins

FIG 8

## Conclusion

It may seem at first that it is defeating the object if tape must eventually be used for storage purposes, and indeed, if a disk-based system were being used purely in the same way as a stereo or multitrack tape machine, it would. Hopefully however, this article has shown some features of disk-based recording and editing which are either impossible, or would take a great deal of time and hassle to achieve using a tape based system. This does not mean that hard disk recorders are suitable for everyone's needs and that tape no longer has a role in audio production. But disk based systems do have their advantages, particularly when it comes to sonic fidelity, editing and allowing the user to quickly try out different arrangements of the audio without being destructive. □

In Part 2 of this series we shall cover the main features of disk-based systems, explaining the jargon and what to look for should you be interested in reviewing such a system.



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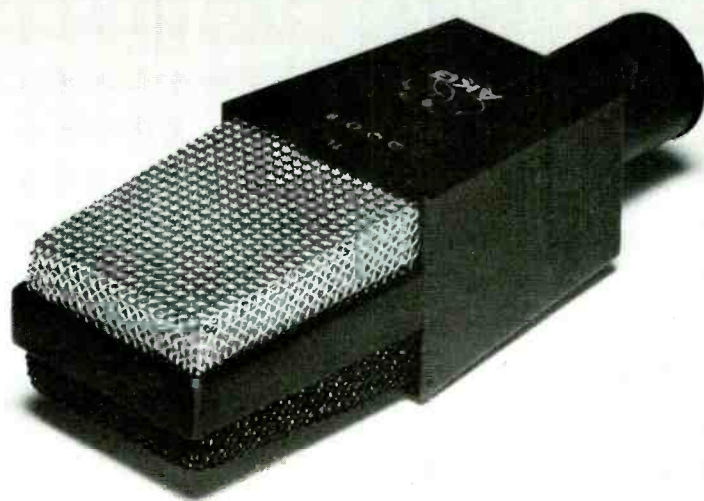
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# APRS PREVIEW

This year's annual exhibition of the Association of Professional Recording Studios will be held at Olympia 2, Olympia, London from June 7th to 9th. As usual we have compiled a preview of the exhibits from information available to us at the time of writing. Studio Sound will be exhibiting in conjunction with sister publications One to One and Broadcast Systems International on stand no 020. Both editorial and advertising staff will be in attendance at the stand and around the show

## A

● **Acoustics Design Group:** details of past and future studio design projects with full information on their services. ● **Agfa:** the complete range of Agfa magnetic products including digital audio tapes, analogue audio tapes, loopbin duplication tapes and cassette tapes. ● **AKG:** four new products, the *C426B* a large diaphragm studio condenser microphone developed from the AKG *C422* but with miniaturised electronic design; the *C525S* condenser designed as a budget line mic; *The Snakeless System*, a digital distribution system capable of carrying 32 channels including 8-channel foldback; the *K270* Studio Closed Back Monitor Headset incorporates two transducers in each earpiece designed to focus the audio signal into the ear canal. Also on show will be the full range of condenser mics and systems, *Dynamax* cartridge machines, dynamic processors, the *ADR* signal processor and the *TDU 8000* digital delay unit. ● **Akai:** *DR-1200* digital audio multitrack

recording system. Also a specially designed system will be on show featuring the Akai Digital Matrix patchbay and the *S-1000* digital sampler to demonstrate various audio/visual applications. One of the main features of the system is the *S-1000 Timestretch* capability, which allows for the stretching or reducing of samples without altering their pitch. ● **Albemarle Financial Planning:** no information available. ● **Allen & Heath:** range of mixing consoles. ● **Amek/TAC:** featured will be the *Mozart* mixing console derived from the *APC1000* using an all-input approach, available in 40-, 56- and 80-input frame sizes with 32 buses and 12 stereo aux sends. An automation system has been developed in conjunction with Steinberg but other automation systems can be retrofitted. Also the *APC1000*, *G2520*, *Classic*, and the *BCII* with *ESM32* serial interface. TAC products include the *Bullet*, a new compact mixing desk housed in a free-standing chassis with the ability to rackmount. Basic configuration is 10/4/2 with 4-band EQ, mic/line

inputs, phase reverse and phantom power, etc, suitable for a wide range of applications in sound reinforcement, video production, broadcasting and theatres. *Matchless*, *Scorpion* and the *SR9000* Live Sound *Superconsole* will also be featured.

● **Ampex:** full range of magnetic tape products for professional digital and analogue applications. ● **AMS/Calrec:** demonstrating *Version 8* software for the *AudioFile* and new features including *ADR*, enhanced machine control functions and *TimeFlex*, time compression/expansion program. The *Logic 1* digital audio mixer with *AudioFile*, The Virtual Console System, the *UA8000* music recording console, *S-DMX* stereo digital delay line, *A/V Sync* audio delay for video, *RMX 16* digital reverberation unit, the *Soundfield* microphone and M/S microphone. ● **Anner Connectors:** full range of connectors. ● **Applied Microsystems:** displaying new products the *CM210* video inserter and *CM220* bi-phase to timecode converter. The *CM220* enables an audio machine or VTR to follow a film transport by using it together with the *CM200* synchroniser. Existing products on display will be the *CM250* control synchroniser and the *CM200* chase synchroniser. ● **Armon Electronics:** range of ALPS components. ● **Audio Design:** production versions of the *ProDAT* series of *RDAT* recorders. A new broadcast networking unit *ProDAT 1B* allows all functions to be remotely controlled by computer for downloading of programmes to a network of units, via satellite or land-lines. *ProDAT 2* is also expected to be in production



AKG C 426 B combi mic



TAC's Bullet mixing console

with EBU/Sdiff2 interface and Apogee filters. Also on show the *Level Mode-Defier* for use on EBU lines providing a high quality dithered signal. A new range of digital *Pro-Boxes* will be available offering interfaces to and from EBU to other digital standards. *Pro-Box 1* allows transfer from CD format and converts SP to EBU or allows EBU to be decoded as SP, copy and emphasis flags are indicated. *Pro-Box 2* interfaces to and from Sdiff2 and EBU/SP, while *Pro-Box 3* gives a full digital interface between EBU/SP and *F1* processors via a simple modification kit. SPL psychoacoustic processors will be on display alongside Audio Design's limiter/compressor range. ● **Audio Developments:** first UK showing of the *AD081 Flexi-Link*, which consists of a 3U rack into which can be plugged a variety of modules, mic input, line input, mixer module and summing amp. Each mic or line module is in a 1/4 format and is therefore capable of distributing a single signal to four separate destinations, it also has a 10-way selector switch that enables it to use as its input source any one of the other

Recently a few dealers have complained about our second hand and ex demo list. It seems they are losing too many customers. Being the largest single supplier of 8 and 16 track equipment in Britain we've decided we can afford to give away a few secrets! We simply tell customers that if any new equipment you purchase breaks down in the first two months, we won't fix it. **We will replace it! RESULT.** Yet another customer who knows that Thatched Cottage can be relied on, and a secondhand list full of the latest gear, factory repaired in mint condition, and with full guarantee **SIMPLE!** We didn't become the biggest without being the best.

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Lexicon PCM 70 .....	£1,199
Yamaha TX16W 16 voice sampler & full 30 disc factory library .....	£1,099
Yamaha DX5 .....	£699
Tascam MS16 - as new .....	£4,500
Casio F21 sampler - boxed as new .....	£899
Yamaha DX7IID .....	£799
Yamaha WX7 Midi wind controller (NEW) .....	£249
Korg DRV3000 20K multi processor .....	£499
Revox B77 .....	£699
Fostex 4030 synchroniser .....	£999
A&H Sigma 24T consoles (several available) .....	£8,999
Fostex EB (10 inch spool) 8 track .....	£1,499
C Audio amp .....	£299
Hill 500 watt power amp .....	£499
Yamaha ML47 mic line amp .....	£199
TC 2290 plus foot controller .....	£1,500
Neumann KM84 (x 2) .....	each £250
Fostex E16 demo .....	£2,750
Yamaha PF85 piano .....	£699
Ensoniq ESQ1 .....	£599
Bel BD240 .....	£499
Bel BD80S .....	£599
ART 4-way video monitor (rack) .....	£299
Yamaha KX88 mother keyboard .....	£899
Yamaha DMP7 automated mixing .....	£1,299
Apex type C .....	£199
Tascam MSR 16 (1/2 inch) .....	£3,499

Plus loads more - give us a ring!  
All prices exclude VAT

Soundcraft MkIII 24 track with full remote control, brand new, boxed, full guarantee, last one ever ..... **£11,999 + VAT**

#### CASIO DA2

The next generation of Casio portable DAT machines has finally arrived. Full size connectors, new design, more control and the same low price makes it well worth considering. Price £650 + VAT, including the rack kit. (We also stock the Sony DTC 1000ES if you want the Studio Standard, including the conversion.)

Due to overwhelming demand, we have finally produced a Thatched Cottage Newsletter. As well as giving details on some VERY special offers, it contains a complete secondhand and demonstration list. (The list we advertise represents only a fraction of actual stock). There are also details of courses and classes we briefly introduce ourselves! Why not go on our mailing list and write or telephone for your copy? We also have a free 40 page colour magazine due out in January full of bargains, up to the minute product news and articles. Give us a call for your free copy.

#### SOUND IDEAS CD LIBRARY

6 discs with 3,500 samples - sound effects plus every instrument you can think of; call for details ...£299 + VAT

We have been appointed sole agents for the amazing Allen & Heath Sigma 24 track MIDI recording console. If you require any information or would like a comprehensive demonstration in our own 24 track studios, why not give us a call? - we think you'd be surprised!

#### YAMAHA SPX1000

Anyone who has heard about the ULTIMATE Yamaha multi-processor should give us a call for details - Don't Miss out!

**ALLEN & HEATH SABER 16 & 24 TRACK CONSOLES**  
At this year's APRS, Allen & Heath launched a revolutionary new professional mixing console - The Sabre offering the quality of a Soundcraft and the durability of a TAC. It has comprehensive MIDI facilities as standard offered only as options by other manufacturers.

Demand has been so great, every month we sell the entire UK production run in advance!

If you're considering spending around £5000 on a high quality multi track console then you owe it to yourself to check this one out. Give us a call and we will send you full details and arrange a demonstration.

#### SPECIAL OFFERS

Fostex E16 ..... £2,999 + VAT  
Atari 1040 + monitor + Steinberg Pro 24 Version III or C-Labs ..... £675 + VAT

• EXPORT • FULL CREDIT FACILITIES AVAILABLE • MAIL ORDER •



**Thatched Cottage Audio**

Tel: Cambridge (0223) 207979 (3 lines)

Fax: (0223) 207952

Thatched Cottage Audio

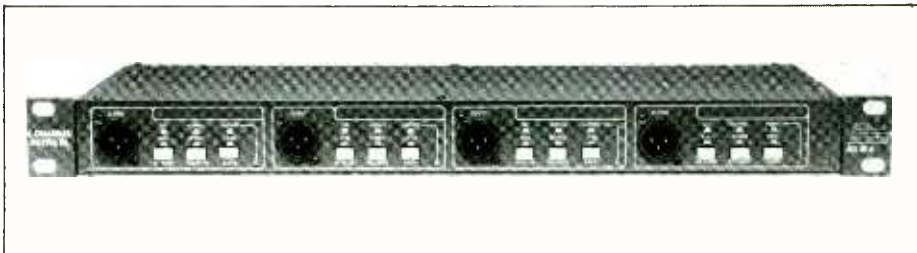
North Road, Wendy, Nr. Royston, Herts.



nine modules in the rack. Also new is the *AD066-12 Flex-EQ*, a 2-channel, 2-band fully parametric equaliser with a link switch that allows the two channels to provide 4-band equalisation. • **Audio Kinetics:** new for APRS will be their *Mastermix II* console automation system, which integrates the *Reflex MX844* Mix computer and colour monitor with the *AK2 VCA* fader units from *Mastermix*; recently introduced is the *ES Penta*, an ESbus controller/autolocator. Existing products on display include the *ES E1.11* ESbus synchroniser, *ES Eclipse*, *ES SSU*, *Reflex*, *Wiper*, *Pacer*, *Pacer Pad 2*, *Striper*, *Gearbox* and *Q.Lock*. • **Audio Systems Components:** products on show include *Minx 3/1* radio OB or ENG mixer, *D2A D/A* converter, and *Pro-partner* AC/DC active monitor speaker. On demonstration are two computer applications for the Sony *CD-K006* 60 CD jukebox system *Trackstar* and *Data-FX*. • **Audix:** new products include a Digital Adaptive Telephone Hybrid with improved



DT 770 pro headphones from Beyerdynamic



#### BSS Audio AR 416 4-channel active DI road and studio versions

frequency response, the new Radio Continuity Consoles specifically designed for the live radio broadcast industry, a working version of the AAT Audix Assignable Technology audio console, demonstrated with multitracking facilities and a range of rackmounting amplifier modules enabling microphone amplifiers, distribution, line receive equaliser amplifiers and line send amplifiers to be created out of a single design. • **Autograph Sales:** products from Meyer, Summit, Klark-Teknik, BSS Audio, Micron radio mics and Lexicon signal processors. • **Avcom Systems:** cassette duplication equipment including the *6120XLP* pro series system from *Telex*.

## B

• **BASF:** full range of magnetic tape products including digital audio tape, analogue audio tape, loopbin mastering tape, duplication tapes, and the range of calibration tapes and cassettes. • **Bel Marketing:** noise reduction and signal processing products. • **Beyer Dynamic:** new *DT770* pro headphones; new radio mic *S186* with integral aerial and condenser capsule; first showing of their recently introduced 350 W power amp; new styled *DT109* combination headphone/mic alongside the new *MC740* wide-diaphragmed studio condenser microphone with new accessories. The full range of other Beyer products will also be on display as well as the full range of Klotz pre-made cables, for whom Beyer are sole UK distributors. • **Britannia Row Sales:** new

products from Howetech, *The Phase Chaser*, able to automatically eliminate stereo phase error and correct phase inversion, applications include cutting rooms, tape duplication and broadcasters. Also products from Sonosax, ANT-Telcom, Lyrec, Aquarius, Klipsch, BGW, Westlake and Trident. • **Bruel & Kjaer:** launching the cardioid microphone type *4012*. The *4012* is a pre-polarised condenser with hyper-cardioid directional pattern and is powered from the Bruel & Kjaer power supply *2812*. The *4012* is a development of the *4011* and offers higher specification for cardioid mic applications. Available will be limited edition boxed sets of six series *4000* mics, which will include two *4006* omni-directional mics, two *4007* omni-directional mics and two *4011* cardioids. Established products on show include type *4011* cardioid mic, type *4000* omni-directional mic, the *UA 0777* black nose cone for the *4003* and *4006* omni pattern mics providing a true omni response at all frequencies and types *3529* and *3530* stereo microphone sets. • **BSS Audio:** frequency dividers *MCS200* and *FDS360*, the *DPR402* compressor/de-esser, the *DPR502* MIDI controllable noise gate, and the *AR* series of DI boxes, lead and phase checkers. New for APRS will be the *AR416*, a 4-channel 1U rackmount mains powered DI box and the *DPR504* 4-channel noise gate based on the *DPR502*.

## C

• **Cambridge Key Technology:** first APRS for this company and the official launch of the

Monitech *Quatro* amplifiers. These are 4-channel amplifiers designed for PA foldback/monitor use and Dolby cinema sound systems. Models are *Quatro 1000* 4x250 W, *2000* 4x500 W and *3000* 4x750 W. ● **Canadian Instruments & Electronics:** wide range of cables, connectors and accessories. ● **Canford Audio:** distributors of a wide range of interfacing and interconnection products. New products for the show include the *Omnimount* universal mounting system, heavy duty polyurethane jacketed cables and spring-coiled cable assemblies, new studio clock systems, the *KW Reporter Mk II* mono journalist cassette recorder and *CA944* direct drive broadcast turntables. ● **Cetec:** examples from the range of duplicating systems and loudspeaker drive units. ● **Clive Green & Co:** examples from the range of mixing console systems. ● **Citronic:** examples of the range of power amplifiers, processing and mixing products. ● **Connectronics:** a comprehensive range of screened audio cables and many types of ancillary hardware including stagelink systems, cable reels, modular patching systems and patchbays. ● **Crompton Modutec:** on show the *Sovereign* range of vu meters made exactly to ANSI-C16.5-1954, available in four different sizes with the option of window, panel or rear of panel mounting. Also there will be a full range of audio level indicators available in 12 different sizes, and new for this year the *Triton* range of control knobs available in six sizes. ● **CST Manufactur-**



**Bodge plug from Canford Audio**

**ing & Sales:** products for cassette tape duplication including printers and labellers. ● **Cue Systems:** design, sales and rental service for the live sound industry will be showing the unique *Cuedos* computer-controlled snapshot mixing system, the *Cuedos* controller, the *Hackney Cab* professional loudspeaker, the Klein & Steck range of Technology Line Active Controlled loudspeaker systems and the full range of Carver Professional products. ● **Cummings Recording:** first UK showing of the *Pro 65CD*, a hard wire remoteable CD player based on the Marantz *CD65 Mk II*. Established products include the Marantz range of portable cassette recorders and CD players, the full range of Revox and TEAC products and details of their duplication and tape supplies services.

## D

● **DDA:** the *DCM232* production console and the *AMR24* recording console will be shown in new frame construction, the *DCM232* will be fitted with the new processor controlled bargraph system. Other products include the *Q* series consoles, an 8-bus sound reinforcement model and versions of the *D* and *S* series consoles suitable for duplication and transfer facilities. Also on ▷



# Half-rack. All Symetrix.

## The SX200 Series



**SX201**  
Parametric Equalizer/Preamplifier



**SX202**  
Dual Microphone Preamplifier



**SX203**  
Telephone Interface



**SX204**  
Four Channel Headphone Amplifier

The Symetrix reputation for *reliability, versatility* and *ease of operation* continues in the SX200 Series. Backed by *fourteen years* of signal processing experience, Symetrix offers this solid approach to the half-rack format. Watch in '89 for the introduction of new SX200 Series products, which include the SX205 PRECISION AUDIO METER and the SX206 MULTI-DYNAMICS PROCESSOR.

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Fax: 0462-480800

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# Symetrix

Signal processing at its best



**Drawmer's DF320 dual noise filter**

show the established *DD500* and *DD1000* electronic crossovers. ● **Digital Audio Research:** *SoundStation II* with recently introduced features, including digital audio tape backup allowing users to create and compare work faster than ever before, *Timewarp* enables the shortening or lengthening of any audio segment without altering pitch, optical disk backup subsystem provides high speed backup of audio data and edit decisions to 800 Mbyte ISO standard WORM disks, *Find* allowing users to locate instantly a sound or specific data. ● **Dolby:** products for music recording, film and TV post-production, cassette duplication and transmission systems. ● **Drawmer:** first appearance anywhere for the *DS301* dual expander/noise gate, offering auto-attack, peak-attack and balanced inputs and outputs, first UK appearance of the *LA12* line distribution amplifier developed specifically for realtime cassette duplication. Established products include *DF320* universal noise filter, *M500* dynamics processor, *DS201* frequency conscious noise gate, *E101* passive coil equaliser and *M401* MIDI management system. ● **Dyer Audio:** displaying a range of broadcasting equipment including on-air radio broadcasting mixers from Eela, telcom noise reduction from ANT and low power VHF-FM transmitters and ancillary equipment for broadcast stations from SBS.

## E

● **Eardley Electronics:** full range of Neutrik XLR-type connectors, Preh potentiometers and other components for the pro-audio industry.

● **Eastlake Audio:** photographs of projects underway and recently completed. Eastlake personnel will be on hand to discuss new projects.

● **Emberman:** featuring the range of Otis Communications products. ● **EMO Systems:** range of graphic equalisers formerly manufactured by Court Acoustics, the range includes a 2-channel 30-band model and a single-channel 30-band. Also on show is the range of stage and studio ancillaries including the *EMO Direct Injection Box* and the range of cable testers.

● **Essenteam:** an independent finance company that specialises in arranging facilities for the professional audio/visual industries. ● **Evenlode Soundworks:** stand shared with Steinberg Digital Audio who market Steinberg's advanced digital recording and sound processing equipment while Evenlode Soundworks are the distributors of Steinberg soft and hardware products. New products are *Topaz*, an instant access digital recording system, *Mimix* desk automation system that can be retrofitted to virtually any desk, and *Cubit* a MIDI desktop recording system.

## F

● **Ferrograph:** exhibits include the series 9 digital audio recorders, the model 9000 optical recorders and the model 9500/9200 digital cartridge system. The model 9000 uses WORM disk technology and five ¼ inch removable optical disks, which can store up to 90 minutes of stereo music, the model 9500 digital cartridge system will be shown with hard disk storage and *MacSonics* editing. On show for the first time is a

range of audio mixers for broadcast applications ranging from 3/1 mini mixers for OB use and portable 8-24 broadcast mixers to general purpose 16-40 input broadcast mixers. Other products include the series 77 reel-to-reel tape recorders, RTS/ATU audio test equipment and deflexers.

● **Film-Tech Electronics:** new product is the *PAM42* portable mixer with four inputs and two outputs. Ideal for location recording with PPMs, headphone monitoring, microphone powering, attenuators, group select switches, and 12 V battery pack. Film-Tech's range of accessories now includes active and passive MS decoders as well as charges, checkers and discharges for camera batteries. ● **Focusrite:** showing a selection of modules and a demo console. ● **Formula Sound:** two new additions to their range, the *System 2000* modular mixer and the *AMX6* mixer. The *System 2000* is a production mixer designed for applications like broadcast, PA, audio-visual, etc. The *AMX6* is a 6-channel mono mixer. Also on show the *QUE-4/8* headphone foldback system, *PM-80* mixer, and the *SE2* series system equalisers.

● **Future Film Developments:** the new 9000 series range of digital audio distribution equipment based on the new Industry Standard AES/EBU format, products include a precision A/D conversion module, distribution amplifiers and a D/A converter. Also on show is a new analogue range of audio distribution amplifiers using the same Euro Card format as the digital range. Enhancements to the 6000 series microprocessor intercom system include a new version of the *PD6190* intelligent panel. ● **FWO Bauch:** products from Studer, Revox, Sonic

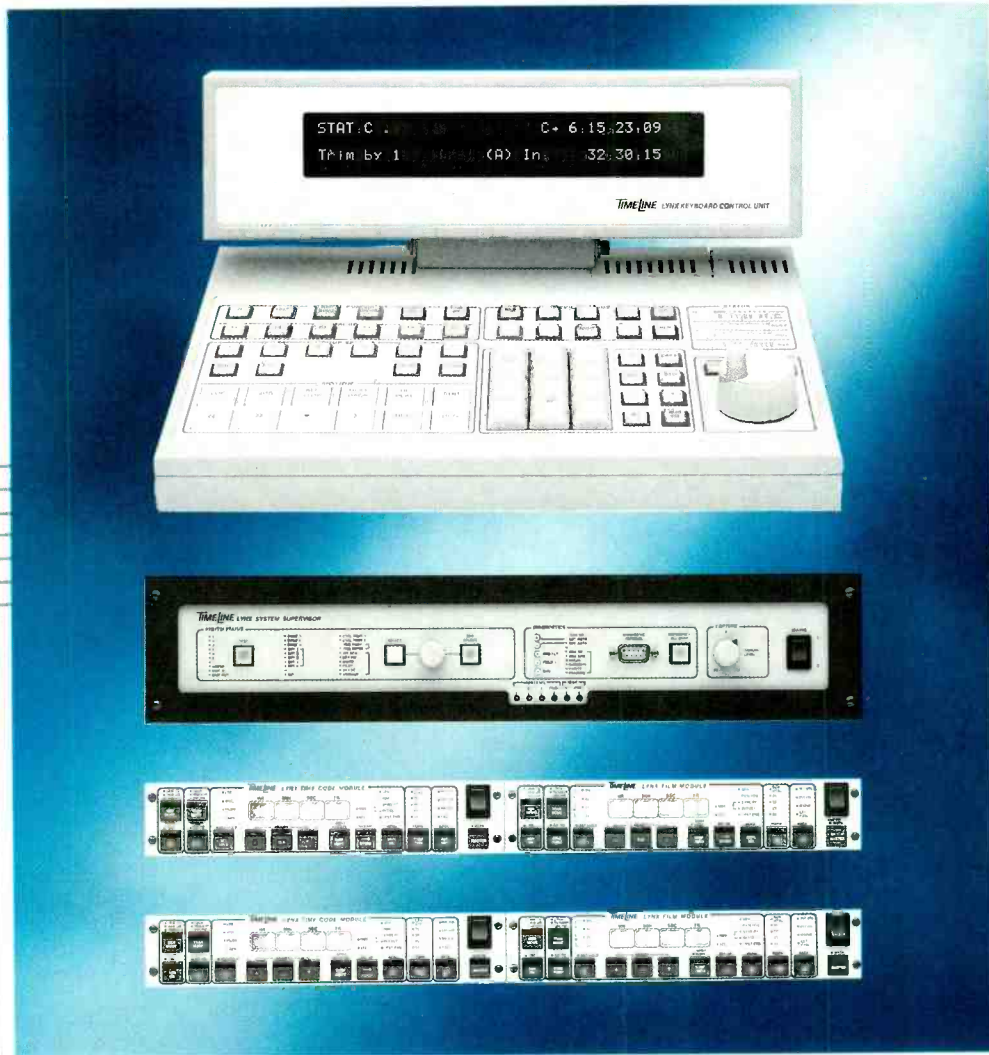
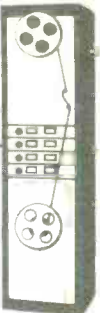
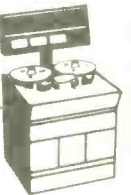
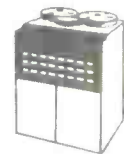
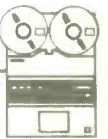
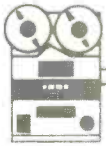


**PR99 III from Revox**



**Nagra T-Audio**

# TIMELINE. TOTAL CONTROL.



**T**he Timeline post-production system is the most comprehensive modular machine control system yet developed, capable of controlling VTR, VCR, Film and Audio transports. The Lynx Module and Lynx Film Module reliably synchronise serial, parallel and bi-phase controlled machines in any simple or complex configuration. Operation may be controlled from the unique Lynx Keyboard Control Unit, which lets you forget the equipment and concentrate on the production. The System Supervisor further expands control by co-ordinating real-time synchroniser communications, GPIs, MIDI and central timecode generation. Integrated advanced post production control at your fingertips. Call today for full details and a personal demonstration.



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**Film-Tech PAM 42 portable audio mixer**



**Denon CD cart player**

◁ Solutions, Harmonia Mundi, EMT, Harrison, Neumann, ITC, Phillips and Gotham. New products include the first UK showings of the A827 multitrack the replacement for the A80VU-24, A723 active monitor, and the 990 mixing console. New products from Revox include the B126 CD player with fader start, *Stereolith Duetto* stereophonic single speaker system, Revox C range of tape recorders, PR99 III broadcast version tape recorder. First UK showing of Sonic Solutions digital editor *NoNoise* signal processing software. New from Lexicon the *Opus* digital post-production system with a 1.2 Gbyte disk drive giving over three hours audio storage. First UK showing of Harmonia Mundi's range of digital systems and the new compressor/limiter dynamics controller. First UK showing of Harrison's *Series 10* automated console with a new computer system. First time UK showing from Neumann of their *K100* system, a range of miniature condenser mics replacing the existing *FM80* series. From Gotham their range of cables including the first UK showing of the *GAC-2*, a 2-core audio cable in seven satin-finish colours.

**G**

● **Goutam Electronics:** range of live sound consoles and rackmounted mixers. ● **gtc:** range of video editing and control systems.

**H**

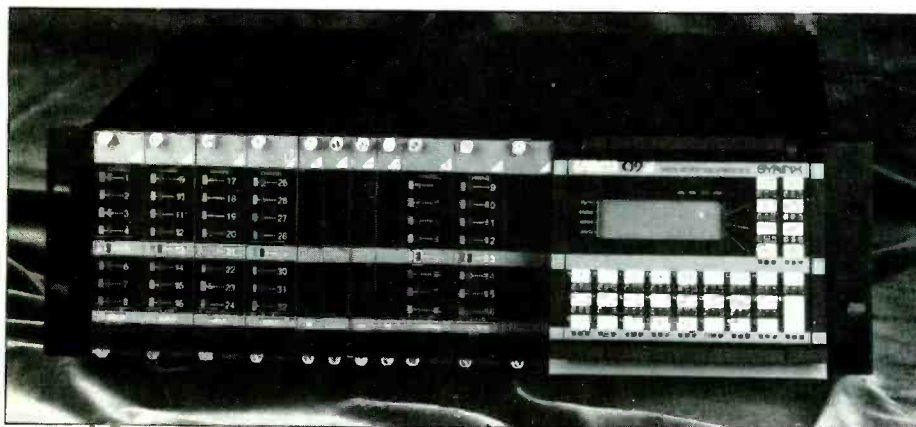
● **Harman Audio/New England Digital:** under the heading of Harman Studio Systems, details of supported products including the Soundcraft range, Otari, Bruel & Kjaer, EAR, JBL and UREI electronics. Fostex products will be exhibited in a dedicated A/V synchronised demo and featured will be the *D20* DAT master recorder, seen for the first time in the UK. The *D20* is the first fully professional 4-head RDAT machine capable of implementing the record/playback of SMPTE within the subcode area. The *D20* will be demonstrated locking with the *4000* series synchroniser system. Fostex tape machines on display include the *R8* 8-track, *E*-series multitracks and synchronisers. The JBL and UREI display will feature JBL's *Sound Power*

series reinforcement cabinets alongside the new *Control 10* monitor/foreground system and *Control 12SR* compact sound reinforcement system. JBL's new subwoofer will be shown with the JBL/UREI *7110* compressor/limiter. New England Digital will be displaying their digital workstations and *Direct-to-Disk* hard disk recording system in all its various versions. ● **Harrison Information Technology:** display products include the *Xi-series* MOSFET amplifiers ranging from 150 W to 2000 W, the *XL150* and *XL300* 100 V line amplifiers that generate audio from either AC mains input or 24 V DC battery packs, the AC series of active crossovers and the advanced *GP* series of graphic equalisers, and the *SP2000* modular mixer offering a choice of eight different module options and three chassis sizes. ● **Hayden Labs:** products from Sennheiser, Nagra Kudelski, Denon, Otis and Syrinx. From Sennheiser will be the new range of Studio RF condenser mics plus a wireless mixer for ENG and PSC use as well as the full range of radio and standard mics. From Nagra Kudelski will be a prototype DAT machine, the *NTA 3TC* timecode machine and Nagra Kudelski tape recorders. Denon will be featuring their *DN 950* professional CD player and their full range of products. The full range of Otis products include the *Power Station* mono block amp and the new stereo power amp and sequential mains switcher. The new Syrinx range will include digitally controlled, analogue audio processing and machine control equipment.

● **HHB Communications:** showing the Sony *DTC 1000ES* DAT machine, Technics portable *SV-260* DAT recorder and *SV-360* mains; demonstrations of the Akai *DR1200* digital multitrack, Sony *APR24* analogue multitrack and Sony video products; Audio Kinetics *ES1.11* synchroniser, Roland *R880* reverb and *E660* equaliser, mics from Neumann, Shure, Sennheiser, B&K, Sony and Amcron, monitors from ATC, Yamaha and Acoustic Research. There'll also be a special broadcast audio section including products from Sony, BSS and Soundcraft. ● **HH Electronics:** the *TA* series of compact loudspeaker systems including the UK's first showing of the *TAM3*, a passive high definition 3-way system with sound balance optimised for stage applications. The *EQ* series, *EQ215P/EQ215S*. 2-channel 15-band graphic equalisers. Also on display will be the full range of power amplifiers. ● **Hill Audio:** production versions of the new *LC* range of power amps and for the first time the *ML* series of 100 V line amps. Also on show will be the established *000* amps and the console range including *Remix*, ▷



**HH Electronics graphic equaliser EQ 215P and EQ 215S**



**Syntrix USM 09 universal switchpoint/mixing automation system**



# “Neve Je t’aime!”

Polygone Studios has received a design award for their new purpose built studio complex. The studio was “Number One” in France for the number of hits recorded in 1987. “The biggest hit of the studio has been the Neve V series.”

Jacques Bally Studio Owner.

“Neve V series Je t’aime!”

Jacques Hermer Chief Engineer.

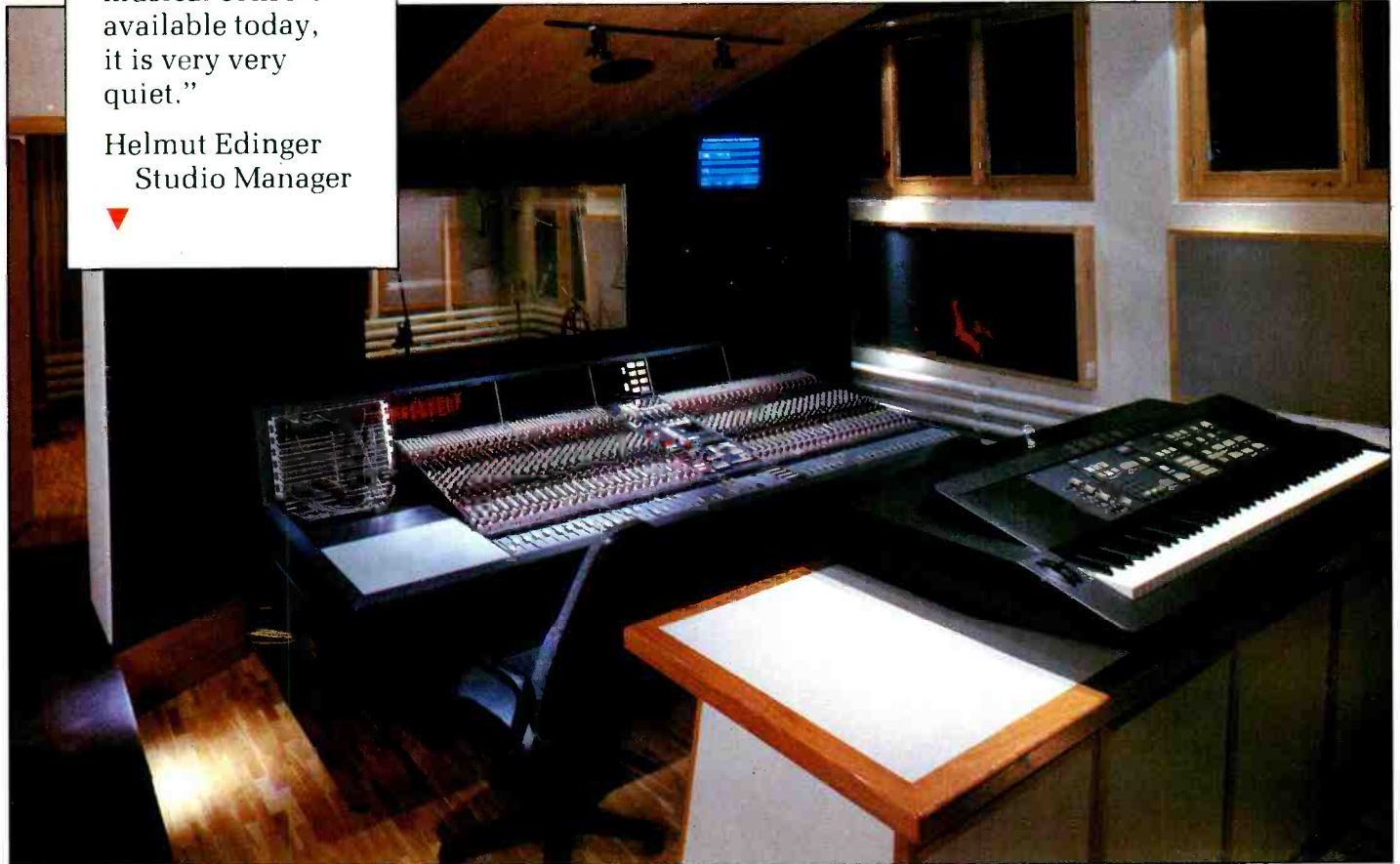
Blackwood Studios uses the Neve V series for music recording and for live broadcasts from the nearby music club.

“It is in our opinion the most musical console available today, it is very very quiet.”

Helmut Edinger  
Studio Manager



POLYGONE STUDIOS – TOULOUSE – FRANCE ▲



BLACKWOOD STUDIOS – BASEL – SWITZERLAND ▲

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A Siemens Company

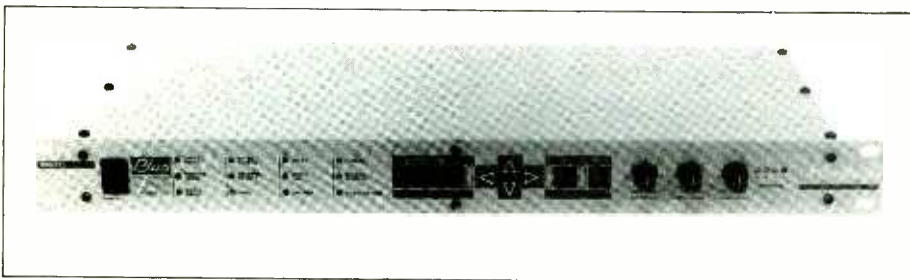
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[www.americanradiohistory.com](http://www.americanradiohistory.com)

◁ **Concept, Soundmix and Multimix.** • **Hilton Sound:** details of their Europe-wide hire services with offices in London and Paris, on display both *DASH* and *PD* multitrack format machines, *AMS AudioFile* and a good selection of outboard devices, microphones, amplifiers and monitors. • **Home & Studio Recording:** UK recording magazine. • **HW International:** new *Beta* range of Shure mics, the full *SM* range, including the *SM84* supercardioid lavalier system, the upgraded classics *55SH series 2* and *520D*, together with Shure field products, problem solvers, teleconferencing, automatic mic and wireless systems. New Carver equipment includes the *PM100* 100 W power amp and a 240 V version of the *PM2.0t* delivering 465 W channel. New for APRS are a range of powered and unpowered 8- to 24-track mixers from Italian manufacturer Discovery.

## I

• **ICM:** *C-0* shells including coloured and transparent sonic welded, screwed coloured and transparent library cases. Also details about latest developments in cassette and compact disc technology. • **International Musician:** UK



DSP 128 Plus from DigiTech

magazine for the musician. • **ITP:** International Trade Publications.

## J

• **Jackson Music Group:** details of second hand equipment for sale including complete facilities. • **John Hornby Skewes:** displaying *DOD*, *Digitech* and *Audio Logic* signal processing equipment, *Audio-Technica* microphones in the *Arist* and *Pro-series* ranges, under the *JHS* brand name there will be radio microphone transmitter systems, blister-packed cables, plugs and sockets. Also *Jackson* and *Charvel* guitars, *Seiko* metronomes and tuners, *Istanbul* cymbals and a wide range of other products.

## K

• **Keith Monks:** wide range of ancillary products. • **Kelsey Acoustics:** featuring the *Anner* range of connectors, also the full range of cable connectors, patchbays and accessories. • **Kemps Group:** music industry directory. • **KFA:** studio designers. • **KGM Studio Specialists:** studio designers. • **King Instrument Corp:** featuring an *RDAT* cassette loader and a fully automated audio cassette loader. • **Klark-Teknik:** the series 300 range of graphic equalisers, the *DN60* realtime spectral analyser, series 700 digital delay lines with the new *DN726* stereo broadcast delay, *DN780* digital reverberation system, series 400 parametric equalisers, new series 500 dynamic processors, which include *DN500* offering variable knee compression, independent limiter and clipper and a variable ratio expander/gate and the *DN504* providing four channels of

compression in 1U of rack space. The latest *Midas XL2* auditorium console and the full range of *Milab* microphones for whom *Klark-Teknik* are sole UK distributors. • **Klotz UK:** studio/broadcast cables including multicore, loudspeaker, microphone and single screen cables, as well as a selection of their latest interface products. • **Korg:** will be showing examples of their range of synthesisers and signal processing equipment. • **KW Electronics:** first UK showing of the standard broadcast console *BC1808*. From the basic frame customers can design their own layout as most modules can be plugged in any position. Also on show will be the *KW Reporter Mk II* with a new electronic transport system.

## L

• **Lindos Electronics:** the *LA100* audio analyser measuring system comprising the *LA101* synthesised oscillator and *LA102* measuring set. • **Lyrec:** first UK showing of the *Frida* portable 2-channel tape recorder. Features include 3-speeds, servo-controlled wind, dump mode and variable spooling with speed-sensing tape-lift and search functions. The full product range includes the *P440* high speed loopbin.

## M

• **Marquee Electronics:** display of products distributed. • **Martin Audio:** examples of their loudspeaker systems and processing electronics. • **Michael Stevens & Partners:** newly distributed products include *The Studio Booth*, a prefabricated acoustic booth, the *np elektroakustik* location mixer and the *Soundcraft SAC200* broadcast console. Established products from *Audioscope*, *KEF*, *Rodgers* and *Uher*. • **Minim Electronics/AES (Audio Engineering Society):** *Minim* will have their range of presenters' clocks, studio clock systems and Ambisonic decoding equipment. *AES* will have full details on forthcoming *AES* events, publications and membership details. • **Mitsubishi Pro-Audio Group:** first showing at APRS for *X-880* 32-track digital recorder and *CS-1* chase synchroniser; also on show *X-86HS* 2-track digital recorder, *X-86C* 2-track digital recorder, *X-E2* digital editor, *X-850* 32-track digital recorder, *X-400* 16-track digital recorder and *X-86* 2-track digital recorder. • **Mix Magazine:** US recording magazine. • **MTR:** series III range of consoles led by the *ME 16*, an 18-channel 16-track model. Derived from the *ME 16* are 12- and 16-channel 8-track versions. All models feature a *Line 2* input on each channel for *MIDI/sequencer/expander* signals, doubling the number of inputs available in record and mixdown. Other products include a dual noise gate, three *MOSFET* power amps, a stereo 10-band graphic equaliser, a 40-way stereo jack patchbay and 27-way *MIDI* patchbay, an active *DI* box and the *Gain Brain* mic/inst pre-amp, *Statik Raks* enclosed 19 inch racks. Additional products

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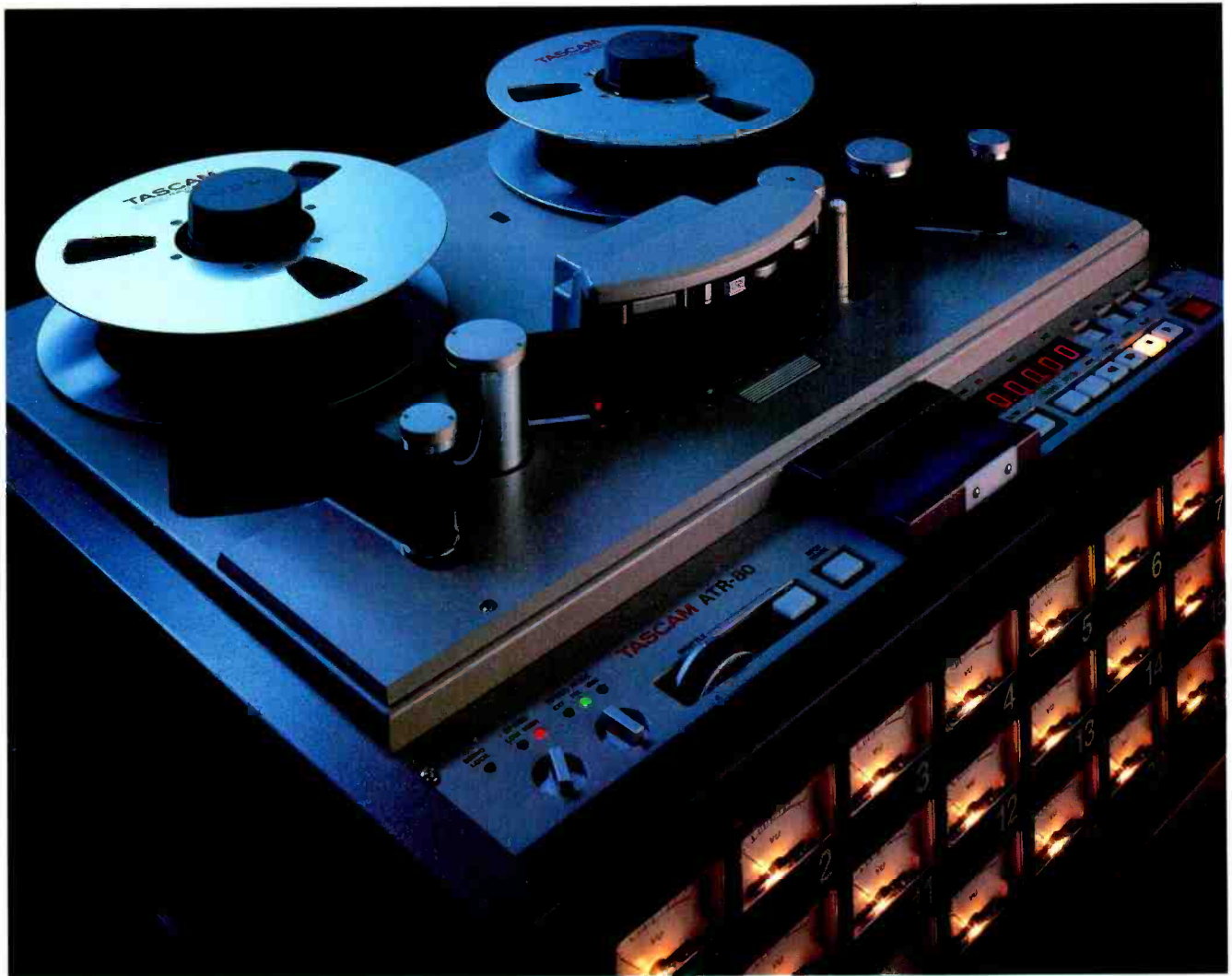
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## N

● **NEAL:** models from the wide range of recording and broadcast studio cassette machines will be shown. ● **Neve Electronics:** being shown for the first time in the UK is the latest version of the *V* series audio console, the *VR* console incorporating a host of new features including the ability to display stored control settings for accurate recall of console configurations. Also new for the UK is Neve's fourth-generation automation system *Flying Faders*. Also being shown is one of the first production consoles from Neve's new *66* series for radio and television and production. ● **Northwood O'Neill:** no information available. ● **Novation:** will be unveiling their new assignable mixing console, featuring total automation of all signal paths to SMPTE.

## O

● **Otari:** featured will be the *MTR-100* 24-track machine, the *DTR-900 B* 32-track PD format digital multitrack and the *EC-102* synchroniser. Existing products on show include *MX-80*, *MX-50* series and *MX-55* series.

## P

● **Peavey Electronics:** the *AMR* product line incorporating synchronisation control equipment, digital effects units, automated equalisation, reference monitor speaker systems, microphones, power amplifiers, production mixing consoles, ancillary products and tape decks; the *SyncController* is a SMPTE-based machine synchroniser/controller with 99 programmable events. Among the new peripheral products are various MIDI devices such as *Map 8x4* MIDI-controlled audio patchbay, the hand-held remote *MIDI Director*, the *MIDI Manager*, the *AEQ 2800* and the *QFX-4*. The *AEQ 2800* is an automated 28-band equaliser, the *QFX-4* offers MIDI-controlled digital multi-effects capabilities being four discrete stereo multi-effects units in a 1U rackmount package which can be operated independently or in serial/chain mode. ● **Penny & Giles:** recently-launched motorised rotary faders with touch sensing. Also the UK launch of the intelligent fader using the endless belt principle. There will be the comprehensive range of studio faders and other audio/video/lighting controllers. ● **Plasmec Systems:** new additions to the Mosses and Mitchell range of audio jacks and jackfields include the *JF2/1U* range of jackfields, which allow two rows of jacks to fit in the space normally required for a single row, and an audio jackfield developed with LWT using PCB construction and input connectors to eliminate all interface wiring. ● **Playback:** first UK showing of the Nakamichi pro *DAT 1000* recorder/processor and other *DAT* products from Aiwa, Sony, Technics and Casio; pro *DAT* tape from Ampex and 3M and new service includes printing for *DAT* and analogue cassettes. ● **Preco**



**Electro-Voice FS-212 floor monitor**

**Systems:** first showing in the UK of the *DS-P* digital audio console from Digitec; other products from Apollo Masters, Audiopak, Weircliffe International, Pacific Recorders, Sound Technology and Leever-Rich. ● **Prism Sound:** new for APRS are a digital equaliser with stereo 4-band parametric or graphic operation to 24-bit precision, a digital recording system for IBM *PCs* enabling instant-access disk recording and editing and the *Hitlist Job Control* and Librarian software package for the job control, invoicing and librarian system for audio, video and film facilities. ● **Pro Sound News:** European pro-audio news magazine.

## Q

● **Quad Electroacoustics:** full range of audio products including rackmounting amplifiers from the *520* series and the *100 V* line driver *510*. Also exhibited will be the *606*, *405-2*, *306* amplifiers and the professional version of the *Quad ESL-63* electrostatic loudspeaker. ● **Quested Monitoring Systems:** new products include *H108* a passive 2-way nearfield monitor, *H115SB* sub-woofer, *Q312* active 3-way system with electronics, *Q210b* active 3-way monitor and uprated drive units for existing systems.

## R

● **Radio and Music:** music and radio magazine. ● **Raindirk Audio:** featured will be the *Symphony* multitrack recording console. ● **Ramsa Panasonic:** first showing of the *WP9 440E* power amplifier, also on show the *WRS-840* mixing console and the full range of established power amplifiers, speakers system and microphones. ● **Recording Engineer & Producer:** US recording magazine. ● **Roland:** new equipment includes the *A50* mother keyboards, the *AA*, *CD5*, *D5* and all the new guitar products. Existing products include the *R-880* digital reverb, providing four separate and interactive reverb processors in one unit, the *D* series synths, the *S* series sampling modules and the *MC* series of sequencers. ● **RTI:** manufacturers of high-speed videotape evaluation and cleaning equipment.

Products on show include the *VT Evaluator* which cleans, burnishes and inspects *U-Matic* tape at 30x normal speed, the *Tapecheck 6120* does the same for 1 inch tape, the *4150* inspects and cleans 1/2 inch tape. Also on show bulk tape degaussers, spooler/cleaners and realtime dropout counters.

## S

● **Saturn Research:** featured will be the *Saturn 824* analogue multitrack with auto-alignment; features include noise reduction interface and a tape management panel. ● **SED/Larking Audio:** will be setting up a 24-track control room featuring the *Soundtracs In-line* console, *Saturn 824*, multitrack and Court monitors. Also on show will be products from Tubetech and Bel, and Standeasy audio screens. ● **Sellmark Electronics:** latest *CPA* range of conductive plastic audio track, *MF100-STA* motorised fader with integral conductive plastic audio track and their full range of established products. ● **Shep Associates:** specialists in restoration and customisation of Neve consoles. ● **Shuttlesound:** new products from Amcron include, the *SASS-P* stereo *PZM* microphone and *SASS-13* stereo boundary mount, gated version of *PCC160* and a new lectern mic *LM200/190*; new from Audio-Digital is the *PAD 300/18* digital delay; *BBEs* upgraded *822* and *422*; Electro-Voice have added the *DML 2181* sub-woofer and *DMC 2181* controller to the *Deltamax* range, launch of the *DML 1122*, new *PL* microphone models *PL50/60/70*, a new bi-amped wedge monitor added to the concert sound product range; Furman's new *HA-6* headphone system and a new range of graphic equalisers; Micro-Audio's new expanded range of programmable equalisers and Samson's new portable receiver for video/film use. ● **Sifam:** examples from their full range of *vu* meters and *ppm* indicators as well as low cost audio level meters and panel accessories. On show for the first time will be some examples of a new 2-shot moulding facility, which greatly extends Sifam's control knob range. Also a selection of collet, push-on, pushbutton and slider knobs will be shown together with fuseholders, miniature switches, diodes and LEDs. ● **Sonifex:** selection


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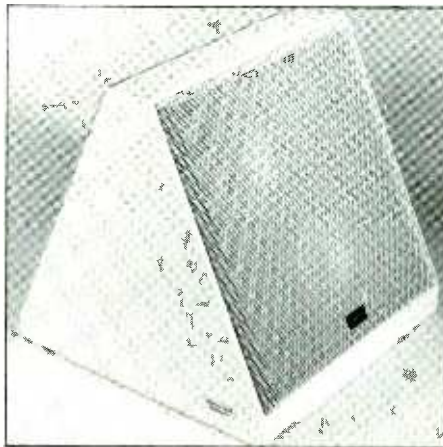
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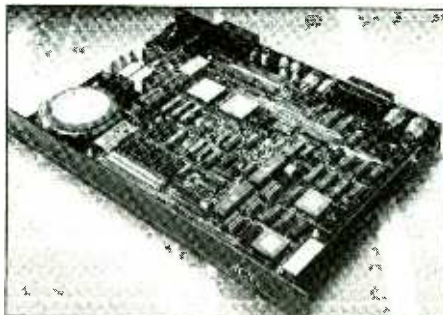
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◁ of broadcast NAB cartridge machines including three new products: a new NAB cartridge known as the *Sapphire*, which offers full compatibility with existing carts but with improved specs; an automatic telephone balance unit *HY02* available free-standing or rackmount; and the *Micro DS*, an FSK data system for storage and retrieval of information each time a cart is played. ● **Sony Broadcast:** featuring the *PCM-3348* digital multitrack in two different configurations, one will be linked to the new *MXP-3056* 56-channel mixing console, the second *PCM-3348* will be operating with the *PCM-3324A*. The *PCM-3402* 2-track recorder and a new product the *SDP-1000* a digital 2-channel effects system. Other new products include a portable DAT recorder the *TCD-D10 Pro*, the 2-track recorder *APR 5003V*, the 24-track recorder *APR 24*, the *MXP 2026* broadcast console and the *ECM MS-5* electret condenser microphone. ● **Soundcraft:** UK debut of the *3200* 32-bus multitrack recording console in a split configuration with 36 inputs and a range of innovative facilities and features. Also featured is the enhanced *Reims* console, the new automation system for the *6000* series and new module options for the *SAC 200* on-air console. Existing products include series *200 BVE* with *VSA 24* serial interface. ● **Sound Engineer & Producer:** UK recording magazine. ● **Sound On Sound:** musician orientated recording magazine. ● **Sound Technology:** new products from Alesis include the *Quadraverb* 16 bit multi-effects processor; the first UK showing of the *1622* mixer, designed primarily as an auxiliary studio mixer and the *MEQ-230* 30-band graphic equaliser; the *1622* and *MEQ-30* feature Integrated Monolithic Surface Technology, a new process that makes more efficient use of material and labour. From Aphex new products are the *Aural Exciter Type III*; the studio clock, a full function SMPTE to MIDI converter as well as an Apple *Macintosh* MIDI interface; the Aphex *Impulse* 12-input analogue to MIDI percussion trigger; and the *Aphex Feel Factory*, the first algorithmic feel composer that allows the user to manipulate MIDI timing and velocity information from an existing sequence or drum machine pattern intuitively and in realtime; all the Ashly processors for PA installation; the C-Lab 64-track MIDI recording software with the new *Human Touch* tempo interface and the *Combiner*, an expansion interface for the Atari computer. New programs include *Explorer M1*, an editor/librarian for the Korg *M1* synthesiser; from Digidesign the new *Sound Tools* digital recording and editing system for the Apple *Macintosh* offering hard disk mastering and editing. The full range of JL Cooper mixer automation and SMPTE/MIDI products includes the new *PPS 100* SMPTE to MIDI converter and event generator and the *Fadermaster* MIDI command controller; Oberheim products include the new *OB 8k* multitimbral synthesiser/keyboard; Symetrix range of studio signal processing. ● **Soundtracs:** featured will be three new products on show for the first time in the UK, the *SPA 3200*, the *FMB* and the *FM-AFV*. The *SPA 3200* is a new PA console; the *FM* series broadcast mixer, the *FMB* is a new 'on-air' console available in two sizes accommodating 16 or 24 channels; the *FM AFV* is an audio follows video controller enabling up to eight channels of audio on an *FMX* console to be controlled from any video editing system with either *BVE* or general purpose interfaces. The *FM AFV* is available factory fitted or as a retrofit. All established consoles will be on show as well as the *Tracmix* fader automation system. ● **SSE Marketing:** new products include the DSP

package for the Audio Precision's *System One* computer-controlled audio test system, allowing the Audio Precision to analyse audio in the digital domain and carry out FFT measurement. New from Schoeps is a 2-channel microphone amplifier with phantom supply and M/S matrix. ● **SSL:** demonstrated will be the new *ScreenSound* digital editing, mixing and recording system for off-line video and film post-production and audio-for-video editing applications. *ScreenSound* interfaces with VTR/VCRs and film reproducers with full machine control. It also interfaces at machine level with the Quantel *Harry* digital video editing system, and in the *Harry* mode offers fully interactive audio and vision editing. Also featured will be the *O1* digital production centre, an integrated digital audio recording, processing and editing system; the *SL 4000 G* series master studio system for multitrack recording and mixing; the *G* series studio computer console automation system; and the *Total Recall* computer system. ● **Stirling Audio:** products include DDA's *AMR 24*-track console, Otari *MTR100A* 2 inch analogue machine, Lexicon *480L* with new version 3.0 software, Sanken *CU-44X* transformerless microphone, the Keyboard Unit and System Supervisor of the *Lynx* post-production system, Alpha Audio *Boss 2*, moving faders from Digital Creations, Audio Kinetics *Reflex* automation system and the wide range of Mogami audio and video cable. ● **Studio:** monthly studio news magazine. ● **Studiomaster:** a new digital module for the *Studiofex* system, *SF812* stereo digital reverb. Also on show Studiomaster's range of accessories including the *ACO1* active crossover and *FCPI* 4-channel phantom power supply. Studiomaster also promise some un-named surprise new products. ● **Studio Spares:** wide range of studio equipment, spare parts and ancillary supplies for the professional user. ● **Studio Timeline:** showing the *Optifile II* automation system, Crystal noise eliminators, the *Bulletin Board* equipment for sale listing and



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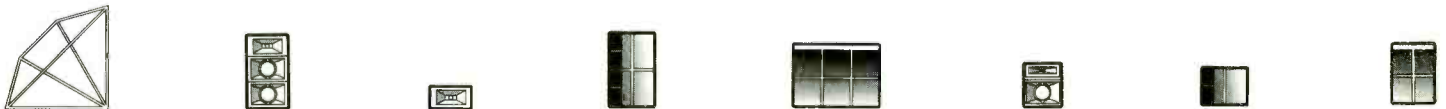
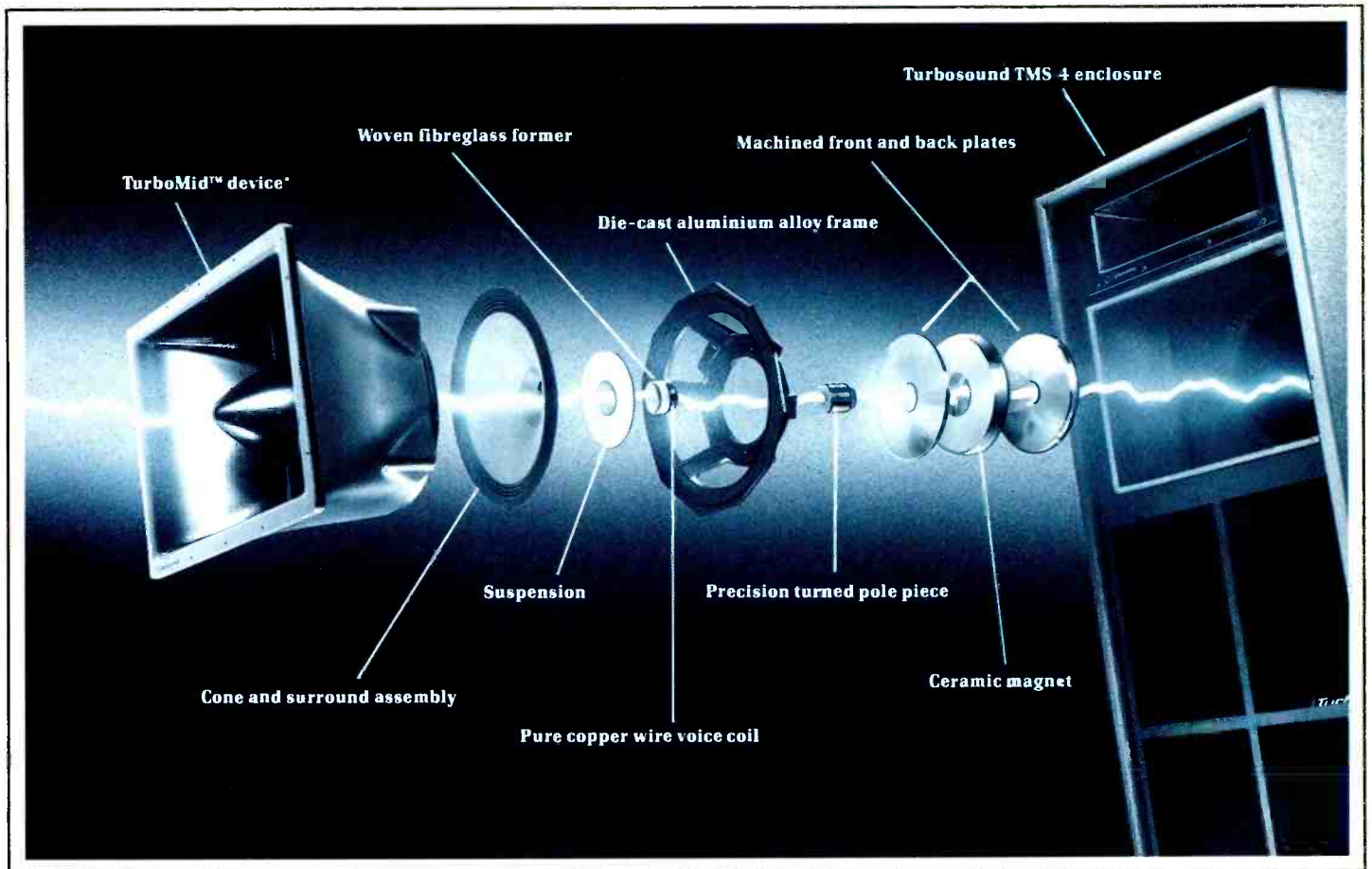
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\*TURBOSOUND PATENT INFORMATION: Australia: 515, 535 Canada: 1,076,033 Japan: X113424/77 UK: 1,592,246 U.S.: RE 32,183 West Germany P2742600/2 Other patents pending.

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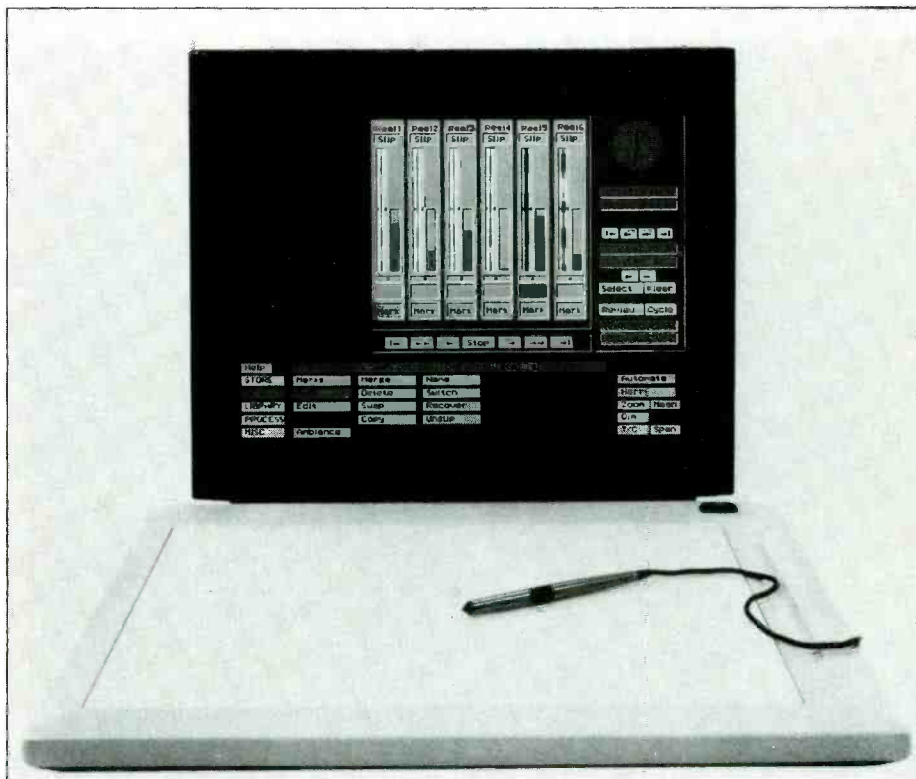
details of Studio Timeline studio co-ordination.

● **Surrey Electronics:** products include the Stereo Variable Emphasis Limiter 3, a protective limiter for live recording and broadcasting as well as dynamic range reduction for pro/semi-pro format transfer, the *Twin Twin PPM* rack AM20/5 microprocessor-controlled ppm system made under licence from the BBC and a stereo and Ambisonics coder with full broadcast spec and capable of handling RDS, SCA and Ambisonics Q and T. The full range of other products will be on display. ● **Syco Systems:** new from Data Conversion Systems (DCS) is the *DCS 900 A/D* converter offering both 44.1 kHz and 48 kHz sampling rates and synchronisation to an external AES/EBU clock or SDIF-2 word clock. Established products are GML Automation, API modules, Akai *DR1200* digital multitrack, ATC monitors and Technics DAT machines. There will also be a hard disk recording system from Waveframe and the Technos *Resynthesis* System as well as products from Emu and Apple Mac. ● **Synton UK:** showing products from D&R including the *Airteq* broadcast console. Nexys hard disks; Axyx speaker systems McGill University master samples and Marion Systems who produce an upgrade board that transforms the Akai *S-900* into a 16-bit sampler. ● **S W Davies:** launching *The Clearpath Audio Routing System*, which

allows signals to be routed around a unit while avoiding redundant circuitry. Also on show the *MA 871* valve microphone amplifier; GC 821 groove control system, a 16-segment computer retrofitted to disc cutting lathes; *Tonemaster* automatic oscillator and studio monitor *LS 841*.

T

● **TAM:** disc cutting supplies. ● **Tannoy:** *DTM-8* desktop monitor, which uses the eight inch dual concentric drive unit, the *FSM* and *FSM-U* studio monitors which use the 15 inch dual concentric with additional 15 inch bass units, and the *SR840* power amp. ● **Tape Automation:** tape duplicating equipment including master transports, slaves and loaders. ● **Tape One Studios:** full details of their mastering and copying facilities. ● **tc Electronic:** complete range of signal processing equipment including the recently introduced *1128* 28-band graphic equaliser and spectrum analyser, the *2290* delay/sampler/effects processor. First time showing for the *1280* stereo digital delay and the *1380* multitap delay. Also showing will be the *8201* digital test generator and analyser, which allows for complete analysis and generation of AES/EBU code. ● **TEAC:** UK launch of Tascam's first 24-track DASH digital multitrack the *DA800-24*. ▷



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tc electronic TC 8201 AES/EBU test generator/analyser



# In an age of disk and digital, why buy analogue?

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The MTR-100's auto-alignment saves you hours of time by eliminating constant tweaking and re-tweaking between sessions.

that this new way will save you hours spent in non-productive time, the analogue choice begins to make even more sense. You see the MTR-100A features full Auto-Alignment that allows total recalibration of the record and reproduce electronics. This means you can compensate for different tapes in a *fraction* of the time that it previously took, and your studio is not bogged down with constant tweaking and re-tweaking between sessions.

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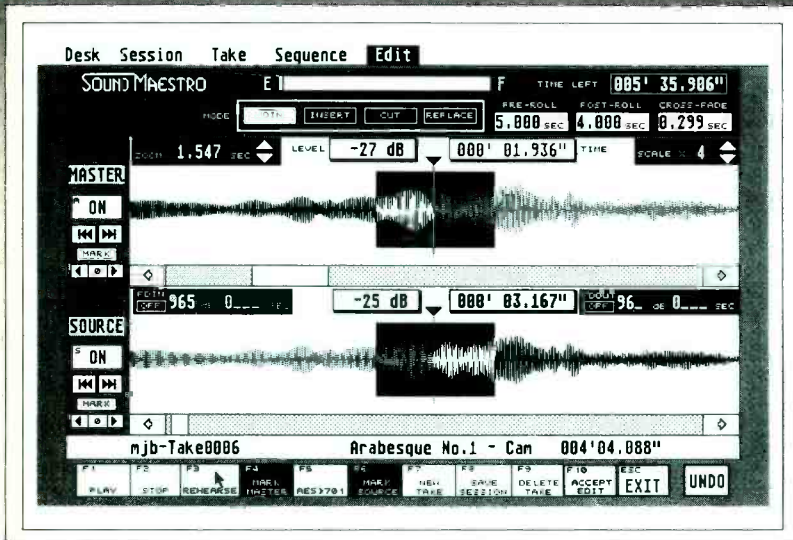
Soundtracs FMB series mixing console

Other products on display include the new *TSR-8* ½ inch 8-track, the new *MTS-1000* Midiizer a 2-machine synchroniser, autolocator and transport controller that will also lock a MIDI system to a ATR/VTR system, the new *CD-701* CD system, *ES-50* synchroniser and a selection of new pro cassette machines. ● **Thatched Cottage Audio:** pro-audio dealer, new and secondhand stock information. ● **The Synthesizer Co:** will have a complete digital studio on their stand to demonstrate the Akai digital multitrack packaged digitally with the Roland *R880* and *E-660*. Products also on show include Acoustic Energy, Apple Mac computers, Atari, Emu Systems *Emulator III* and Yamaha. ● **Theatre Sound & Lighting:** full range of Clear-Com intercom systems including *Series 500* belt-packs and the new Station ISO system designed to quickly establish private, isolated communications between selected people within a party-line intercom system. ● **TIPS:** Training Initiative for Professional Sound. ● **TOA Electronics:** wide range of products from mics to speakers, including the *MR-8T* 8-track cassette multirecording system and the *MR-8A* assign/patchbay for use with the *MR-8T*. ● **Trident Audio:** first showing in the UK of the new updated *Di-An* automated console with *Automate II* software. ● **Turbosound:** first UK showing of two new *TXD* enclosures, *TXD-560* and *TXD-518*. The *TXD-560* is a full-range direct radiating enclosure with one 15 inch custom bass driver, one 10 inch custom mid-driver and a high frequency unit, the *TXD-518* comprises one 18 inch custom bass-driver and has been designed to augment the enclosures in the *TXD* range and provide low-bass reinforcement. Also on show will be enclosures from the *TMS* and *TSE* range as well as wedge monitors from the *TMW* and *TFM* range of floor monitors. APRS sees the launch of Precision Devices in the UK. Precision was formed two years ago primarily to manufacture loudspeakers for Turbosound, now they are introducing their own range of loudspeaker chassis comprising 15 inch, 18 inch and 21 inch, all designed to operate in low-frequency enclosures. ● **27th Dimension:** first European showing of *Gold series* music library; *Gold series* Holophonic sound effects library; *Platinum series* music library and *Hyperflex* sets which are sound effects on *Hypercard* for *Macintosh* users.

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W

● **Webber Tapes:** launch of Studio Reference Books aimed at the recording industry. Studio Reference Books will supply books, reference works, data-books and workshop manuals direct to dealers, studios and engineers. All presently available publications will be stocked and catalogued. Reviews will be available on the Webber stand. Webber Tapes will be displaying details of their complete range of test tapes and cassettes, ¼, ½, 1 and 2 inch reel-to-reel audio cassettes, Beta and U-matic PCM audio format video cassettes. ● **Windmill Munro Design:** full details of the studio design and acoustics consultancy services together with details of recently finished projects.

Y/Z

● **Yamaha-Kemble Music:** full range of signal processors, mixers, amplifiers, speakers and microphones. ● **Zonal:** full range of magnetic recording products for broadcast and film application, including cassette tape and magnetic sound recording film.



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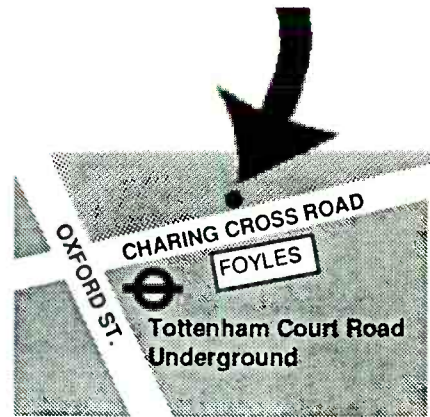
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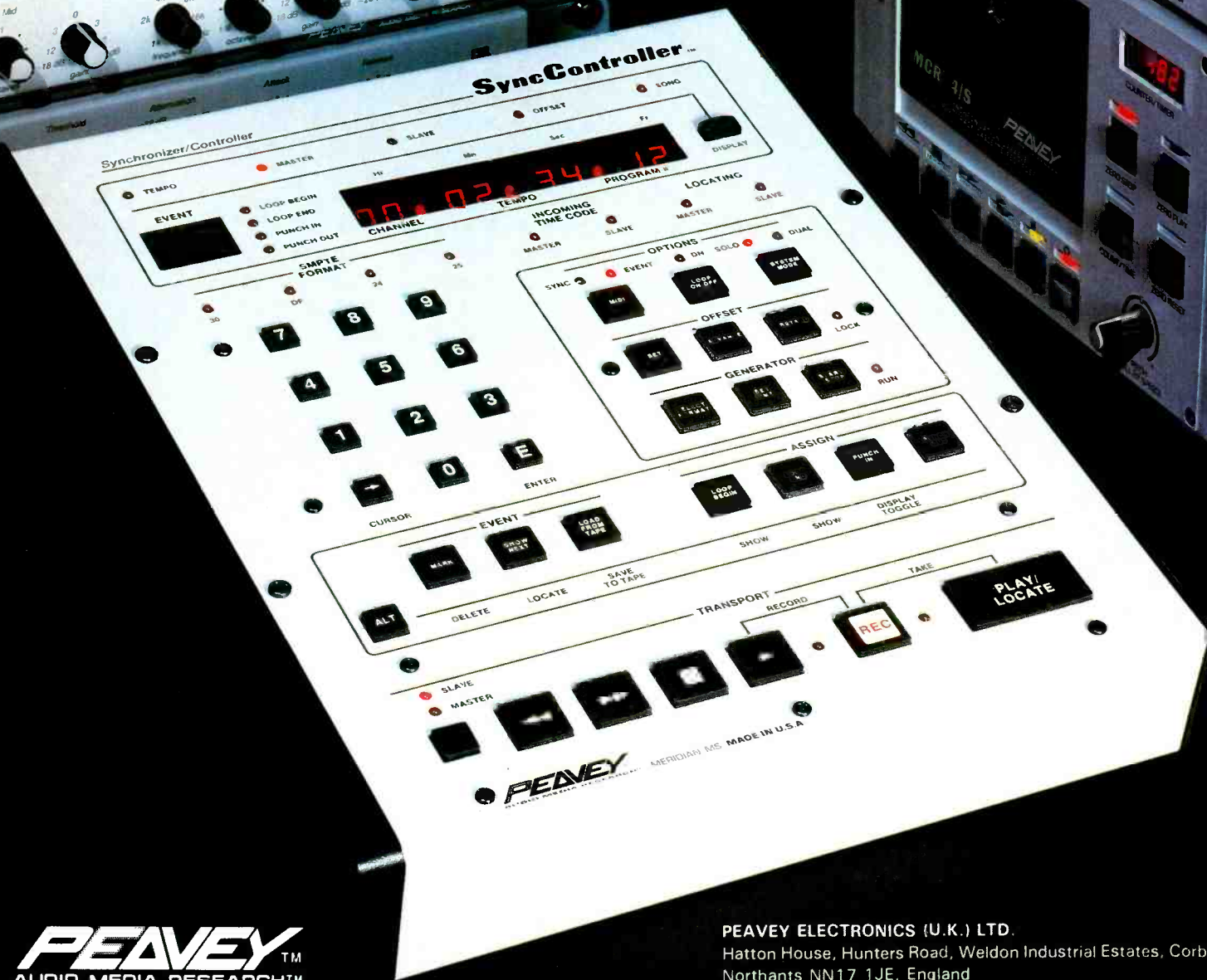
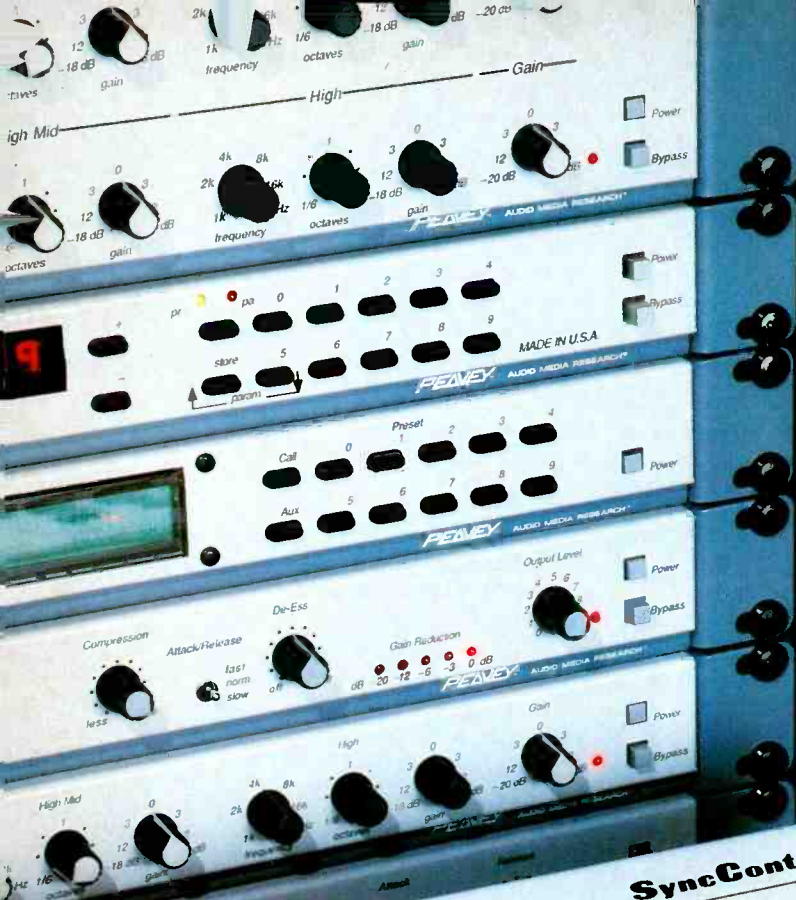
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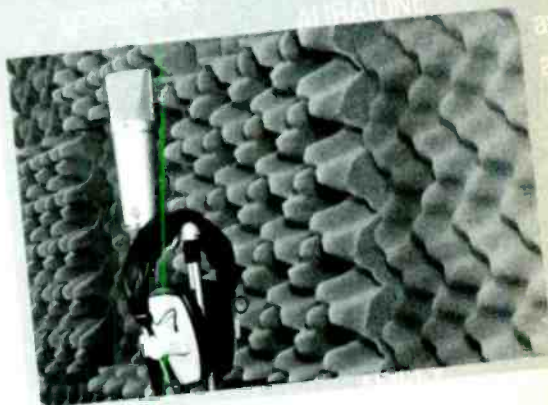
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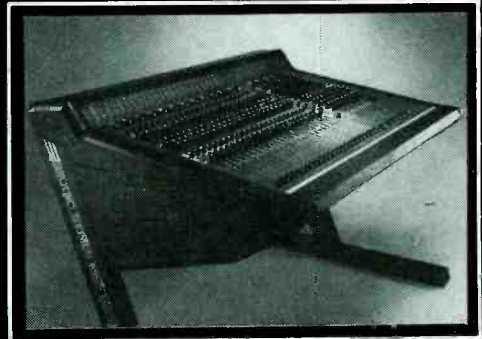
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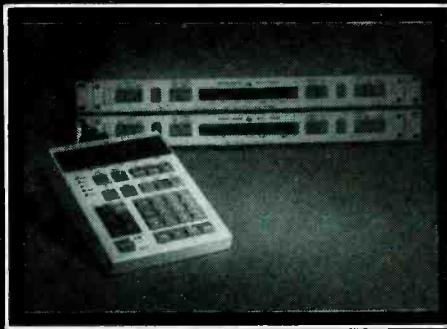


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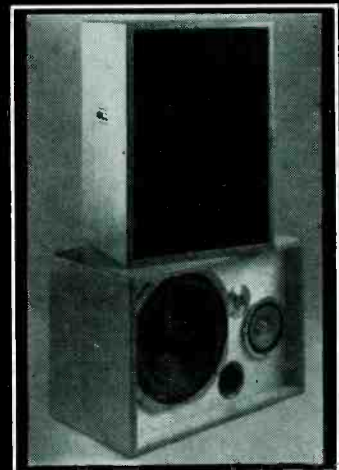
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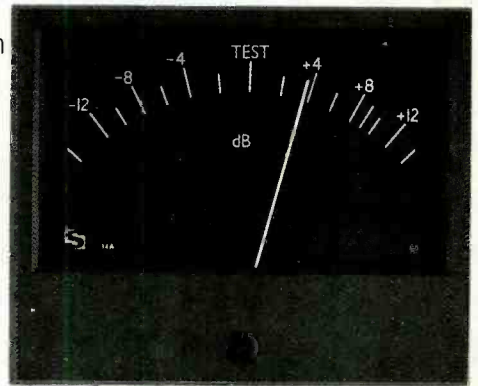


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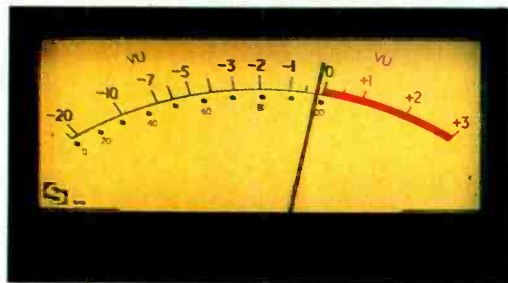
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# ULTRASOUND

## Janet Angus visits a London facility which offers audio post-production for TV video and film

**U**ltrasound is a relatively new audio post production facility for television, video and film. Headed up by managing director David Woolley the company was founded nearly two years ago, operating as a subsidiary of Doublevision, both based in the heart of London's West End at Golden Square.

Woolley's association with Doublevision dates back to his former position as head of audio post production at Trilion. There he pioneered, amongst other things, the application of hard disk recording media in audio post production. These days his dedication to quality audio new technology is tempered by a more cautious and practical approach. His new company Ultrasound builds its reputation on its multitrack digital audio capability for both video and film. The only analogue tape recorder they own is a Studer A810 ¼ in machine.

The rest of the equipment complement in the Woolley-designed control room comprises a Raindirk 40/32 *Symphony* mixing console, Sony PCM3324A digital 24-track, a U-matic picture playback machine, a pair of Genelec 1025A triamped loudspeakers and an Adams Smith AV2600 synchronisation system. An adjoining machine room provides the possibility of all Sony digital audio formats including PCM1630 recorded on U-matic or 1 inch C, PCM3402 DASH ¼ in, BVH2830 digital

audio video tape recorder as well as the PCM3324 multitrack. There are digital interfaces between all machines and sample rate conversion is also available. The Studer A810 ¼ in features all timecode and pulse formats and is used for preparation and playback of original masters in a 16/35 mm 2-, 3- and 4-track film transfer bay.

As a subsidiary of Doublevision, Ultrasound is in a unique position to offer direct access to broadcast video facilities on 1 in, Betacam SP and all international formats.

Woolley has never been nervous of trying new equipment and technology as he illustrated many times at Trilion. His decision to take the digital route was based on a philosophy rather than market trends. Acknowledging that the perceived impression of digital audio is firstly one of expense and secondly 'not the norm' in video and film soundtracks produced in the UK, he is determined that it is, nevertheless, the only way.

"Seven generations is typical of the work we do. I don't think there is any comparison between digital and analogue audio under those circumstances. Digital audio is also significantly easier to sync against picture and is an order of magnitude more reliable—for example signal integrity, drop out, wow and flutter—the tape costs half as much. It just seems to be the thing of the future.

"Yes, digital multitrack is expensive if it means that you have an analogue multitrack sitting in the corner doing nothing, but we don't. We only have one set of equipment which makes it more sensible."

With a staff of three engineers: Woolley, John Wakeham and Jeremy Molloy, the bulk of Ultrasound's work is with music. Doublevision specialises in high quality broadcast video as well as making standards conversion something of a speciality. They do a lot of work for record companies including small runs of pop promos. Some reversioning of programmes is called for and their video editing suite is aimed at versioning. An English production, sold to an American company may require less episodes with a different number of commercial breaks and another voiceover. Ultrasound's client list will bring a variety of projects from straightforward copying jobs to CDV mastering, to Rik Mayall reading Grimms fairy tales for Central

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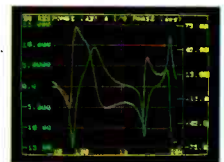


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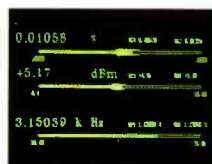
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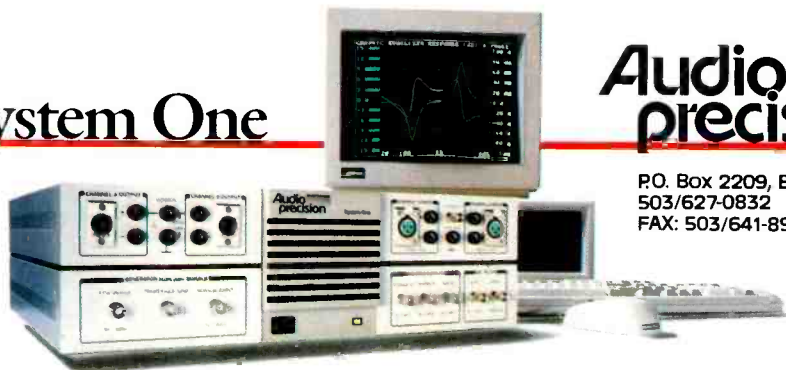
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◁ Television, to post production on the Fleetwood Mobile's footage of the Russian ballet in Leningrad. The two companies complement each other well, enabling each to offer a comprehensive service to their clients.

Woolley first came across the Raindirk consoles in the Fleetwood Mobile. He felt the *Symphony* offered extremely low noise, economical price, good sound and fast availability, and has had no regrets. In fact he is very pleased. "There are aspects of the desk which belie its price. There are hundreds of foldback and auxiliary sends, 90 line inputs to mix, 32 groups, a big patchbay, and there are two stereo buses which you can mix together."

The most recent acquisition is an Adams Smith AV2600 synchronisation system. The AV part of it offers computer control of the 2600 modular synchronisers, via a QWERTY keypad attached to an IBM PC and screen.

"This means that you operate it much like a CMX video editing system: for up to 10 machine edits, for slipping things around, for previewing edits and all that sort of thing; it really is an expansion on systems like *Q.Lock* which I was, and still am, a huge fan of.

"The *Q.Lock's* control surface is its strength and there aren't many synchronisers around that can compete with that. But I haven't found anything yet that this AV system can't do. It's fantastic. It gives you a lot of the functionality of hard disk editors without having to use hard disk media. One of the major benefits of the AMS *AudioFile* system is its capability to control edit decision lists. With *AudioFile* you find a portion of audio you're talking about, define that with timecode numbers and paste into where you want it to go in the programme. The methods you go through with this AV system are really very similar to that—its 'computer' style and the manipulation, of the edit list. The only exception is that the audio samples are heard on tapes.

"I don't deny any of the new functions that hard disk editing offers—direct access to data, non realtime manipulations, minute editing with no pre-roll and so on but I now feel that these manipulations should take place outside the control session recorder and not replace it.

"At Trilion we operated *AudioFile* as the only multitrack in a studio and stored all the session audio in it, which seemed a logical approach. Now I feel that all the session audio should be laid up onto digital multitrack and sections that require hard disk editing should be transferred off-tape, manipulated, then returned to tape—all in the digital domain, of course.

"This approach sidesteps the need for massive amounts of hard disk memory since we only require to load short sections—say 30 seconds.

"Because of this, I'm interested in the new samplers that offer hard disk storage and audio manipulation at a fraction of the cost of hard disk editors.

"I did a project recently sound dubbing Grimms fairy tales read by Rik Mayall. We recorded 12 episodes—approaching 24 hours worth of material—on a single reel of tape. It was done over a short period of time, constantly switching between programmes, so that where similar effects had to be placed on different programmes we would rapidly switch between them. Trying to do all the production on hard disks would have put restrictions on moving around having to load down and load up this limited amount of disk storage in between takes. There were times where I would have liked to add in 2 seconds of studio noise from somewhere else to cover, or a consonant from a word in from somewhere else to cover an extraneous noise—that sort of thing— but now we're talking about inserting little bits, not having a massive amount of memory.

"With the more musical instrument—like hard disk units you can get any sound you like and then manipulate it. That tends to be what our clients want; more to do with sound effects, taking effects from an effects CD and modifying them to suit."

Woolley's main concern about hard disk systems is the reliability of the actual disks. As a pioneer he admits that he was very quick to point out the advantages and brush disadvantages under the carpet.

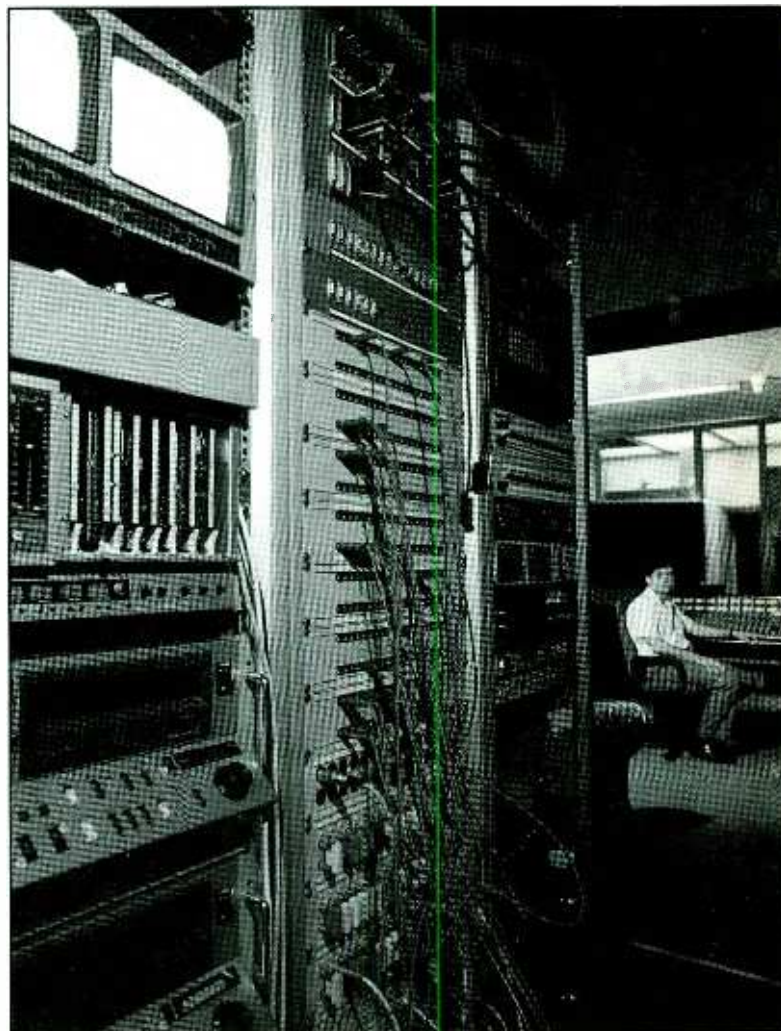
"In my experience disks have broken a number of times. There have been communication problems between the floppy and Winchester disks (floppies are used for manipulation, Winchester for music storage). A lot of studios have bought *AudioFile* and are very happy with it. I was probably expecting

a bit too much of it.

"Aspects of hard disk remain invaluable: others a pain in the neck. There is the problem of limited storage, questionable reliability—whether you'll get the same thing twice, or three times or 10 times or 100 times. It does seem to me that you need the audio juggling capabilities of hard disk in certain phases of your production, but after you've finished juggling them and you like where they are then I think you want a bit more of a full stop after that and you say 'you mustn't let me erase any of these commands I've put in'.

"That's what you can really do with tape. You can record it down onto a track with all your edits in it and then leave it alone and the next time you play it it is still there; and the next time and the next time; and it isn't going to move by half a frame; and the edits aren't going to move. You see there are problems with hard disk caused by all these editing capabilities always being available. It would be nice to stop those capabilities occasionally. Some combination between disks and tape will be the future. There is no question that there are advantages in retrieval systems that are independent of time and position."

The aim is to do as many jobs as possible in the machine room—anything involving simple copying between tapes on the 16/35 mm playback. DASH ¼ in recorder, *PCM1630* and two U-matics plus sample rate converter. There are tielines from here to Doublevision's facilities—video, analogue and AES/EBU digital. A number of jobs involve simultaneously running digital soundtracks played back from *1630* and copying those onto either 1 in analogue or digital (audio) video recorders. In the latter case the audio will be taken down an AES/EBU line. If the video recorder is an analogue audio machine it will obviously be taken down analogue tielines. Two Adams Smith *Zeta 3* synchronisers are employed to lock up between the 1 in machine and the *1630* U-matic.



▷ The equipment room looks onto the mixing desk in the control room

◁ The sample rate converter is used to take digital audio from the digital 1 inch machine—either 48 kHz or 44.1 kHz. If the job is to make a 1630 copy, it will require a sample rate conversion from 48 kHz down to 44.1 kHz. Other clients require 1630 recorded on 1 inch NTSC video tape and not ¼ inch video tape. A typical programme would involve playing back on 1 inch PAL video tape plus a 1630 44.1 kHz tape. The picture would be going through a standards converter and recorded on an NTSC 1 inch machine; meanwhile the sound would be going through a sample rate converter to 44.056 kHz and then coded back to 1630 format and recorded on a second NTSC 1 inch machine.

This complex procedure involves four tape transports, a picture standards converter as well as an audio sample rate converter. It can be offered by the united strengths of Ultrasound and Doublevision and is, in Woolley's opinion one of their undeniable advantages over the competition.

"I don't think anyone else in town can offer those kind of facilities. It is quite popular with American VHS duplication plants. They would like to run their video from 1 inch and their audio from a PCM1630, also on 1 inch. They prefer to have the 1630 on 1 inch firstly because the tapes can go up to 3 hours long compared with the ¾ in which is about 75 minutes, and secondly because they then have two similar tape transports that can be controlled more easily as a pair."

There are three headblocks for the Perfectone 16/35 magnetic machine.

"On 16 mm we run 'centre & edge' a 2-track system which gives you one good track and one medium track. In 35 mm there are two interchange formats (a) triple track and (b) four tracks across the width of the tape. Film dubbing theatres use machines with many more tracks but when people are sending master tapes around they are either 3-track for stereo or 4-track.



**Adams-Smith AV2600 synchronisation system with the Sony autolocate**

Four track is used mainly for LCR tracks which will subsequently be matrixed together into the two Dolby Stereo tracks.

"The discrete and matrixed tapes are interchangeable. You get discrete left, centre, right and surround on the 4-track tape or on the triple you get what Dolby Stereo call left total and right total; these are decoded to be left, centre, right surround in the cinema. For CIC films we master maybe three titles a month in perhaps five languages each for video release. They will send us 12 cans per film per language. Those are normally the 3-track format (left total and right total) and we edit those 12 reels together and relay them onto the video master tapes. That's a major contract for us, which doesn't involve our main studio/control room."

Ultrasound has been Dolby approved for Dolby Stereo dubbing of film soundtracks—an aspect of work which the company hopes to develop further, having worked on a couple of short projects already. Dolby approval is required since the processors are not available for sale, being lodged with studios to use them on productions where a contract has been made and a royalty negotiated. In order to earn approval a studio hosts a visit from Dolby engineers whom they must satisfy that their methods, listening environment, desk, and monitoring etc are suitable.

"We were a little bit unusual since all of our equipment is digital and the Dolby Stereo masters are more usually recorded on 35 mm magnetic. 'We don't usually do it like that' seems to be a fairly stock response from people in the film industry. And there was a procedural restriction that meant that because our digital master was going to be the 'Dolby Stereo printing master' it had to be Dolby A encoded, even though we were going to present it on PCM1630. It doesn't really make any sense but nevertheless that was the way that it had to be. Those tapes were then taken to Abbey Road for transfer from 1630 to 35 mm."

The control room monitoring is expanded during Dolby Stereo sessions. A third, centre, Genelec monitor is required plus a pair of speakers at the back of the control room for the surround channel.

"Something like Yamaha NS10s are sufficient for the rear pair of speakers. The surround channel is frequency limited to between 100 Hz and 6 kHz or something; there isn't a great deal going back there."

With timecode DAT now a reality in the Fostex D-20 Woolley is already well advanced down that road. They are currently working on a series of six 1-hour long episodes for Channel 4, shot on 16 mm film and recorded on a Sony PCM2000 DAT machine. The tapes come back to Ultrasound to be striped with EBU timecode on the Fostex D-20 which has an interface to the Adams Smith controller. Those same DAT tapes are then transferred onto 16 mm magnetic with timecode on the edge track. The film editor listens only to the audio track and whilst making his razor blade edits in the audio track will also cut the timecode track. These cuts relate directly back to the Fostex D-20 timecodes they started out with which can now be auto assembled digitally from the DAT onto the PCM3324.

"The technique has equal applications in trying to offer digital audio for programmes that have already been cut in video edit suites. Ampex, CMX or ISC format floppy disks can all be fed into the AV system. By being more open minded and flexible technically we can now offer to reconvert from people's original audio master tapes. That is something which has been far too time consuming to consider with older synchronisers where you have to enter in all the numbers manually on a keypad—you just wouldn't do it; it would take you far too long and cost far too much money. Having the edits loaded into the machine automatically is a far more attractive proposition. It really is worth going back to the original tapes. I am convinced that sooner or later the feature film industry will move away from 35 mm magnetic sound recording and use more digital audio techniques. I would like to be involved in that."

Film editors generally are able to spend more time being creative, deliberating over editorial changes, paying attention to detail as the facilities are less expensive than those in audio post-production. Digital audio can offer superior quality to the 16 mm magnetic in every generation but until now there hasn't been a workable system to allow the marriage of these two techniques.

"What I think we've found now is some way to meet half way and accommodate productions who want to edit on film. We can very quickly and efficiently spin through and recreate all those edits using the digital master tapes due to the very good edit list management and edit list interchange we've been developing with this Adams Smith machine. When you use the auto assembly function, as long as you keep putting the right play tapes in it goes through and recreates all the edits as they happened in 16 mm. That is a very good offer we can make to producers: better sound quality without imposing completely new work methods. There is no doubt in my mind that the digital audio equipment is far superior, especially in multi generation film productions." □

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# DSP—THE FUTURE OF AUDIO CREATIVITY

## Francis Rumsey discusses the development of digital signal processing and its implications for the future

**D**igital Signal Processing (DSP), is without a doubt the technology that will take the audio industry into the next century. It has implications as important as any of the major audio developments of the last century in that it will change the face of audio production and provide users with a flexible tool for the modification of sound fields. DSP relies on the processing of vast amounts of data at high speeds and thus is directly related to advances in computer technology which the audio industry is able to encompass once sound is in digital form.

An insight will be given into some of the capabilities of DSP with an example taken from the interesting new AKG *Creative Audio Processor* (CAP) in order to gain some ideas about the direction in which we are heading.

## Principles

DSP is based on the mathematical manipulation of digital audio data. If a sequence of numbers represents a particular sound waveform, then by changing the numbers one may change the sound. Clearly it is exactly how the numbers are changed that dictates the audible result.

Essentially, DSP relies on the principle of digital filtering, which involves the successive delay of samples, multiplication by a co-efficient, then adding the result back into the data stream at a suitable point. Depending on the delay and co-efficients, equalisation networks can be built up that simulate boost or cut at certain frequencies; furthermore, the Q of the filter or the slope of an EQ curve depends on how many stages of delay and multiplication are used. It is necessary to realise that time delay without loss of sound quality is easy in the digital domain: it simply means storing a set of audio samples for a time before they are read out of a memory, and the only limit on the delay is the size of the memory. The advance of audio in time is a relative matter as clearly, true advance involves an element of prophecy. It can also be simulated by delaying everything except the signal that is to appear advanced, the only side-effect being an overall delay between the sound entering the processor and that leaving it.

Since time delay is required for equalisation it is perhaps reasonable to assume that any processor capable of EQ will be capable of other effects as well, and this is indeed true. Many of the effects that audio engineers are familiar with, such as reverb, echo, flanging and so forth, are achieved through the use of delay, repetition, and level control of digital audio samples. To give a simple example, a digital echo effect could be achieved by reading samples from the output of the processor into a memory buffer and reading them out again at the specified echo delay later; meanwhile multiplying the delayed sample values by an attenuating value (to simulate the reduction in level of the echo), then adding the delayed signal back into the input. The delayed signal plus the original signal would then appear at the output and the total would go round the delay loop again, the original echo being echoed at a still lower level, at the same time as being tapped off to the audio output.

Time-related functions also come into pitch or frequency control of signals, as it is possible to change the pitch of a signal by altering the rate at which digital samples are converted. Unless action is taken this will also result in a change in the apparent speed of playback, together with the problem that you can't read samples out of a processor faster than the speed you're writing them in. The action required is usually referred to as 'sample rate conversion', and involves digital filtering principles similar to those indicated above, in order to calculate the correct amplitudes of samples at the new sampling rate. This process also involves delay while calculations take place.

In addition to time-related level control of

signals we also have to consider level-related level control. In varying the multiplication co-efficient of samples depending on their level as opposed to their time position it is possible to achieve effects such as compression and limiting. This is not hard to imagine, as the action of an ordinary analogue compressor is that of altering the amount of gain of an amplifier depending on the level of the audio signal. The correct combination of time and level-related manipulation of audio samples is the key to effective DSP.

## Digital mixers

People talk a lot about digital mixers, asking when they will appear. From the above principles it ought to be clear that the mixing of audio signals is just another feature of DSP, and that any processor capable of performing EQ and effects will also be capable of level control and mixing: it only depends on the intention of the designer, and the software that is written. One should not be surprised then that the manufacturers who are experimenting with 'soft' DSP products (those with a graphic user interface) can show a small mixer screen, an effects screen, an equaliser screen and a pitch change screen (some of these may be combined).

By way of explaining the digital mixing process one really only has to imagine again the multiplication of audio data for each channel by a co-efficient corresponding to the fader position, and the addition of time-coincident sample values from one channel to those from other channels in order to mix them together. One side-effect of adding lots of digital sample values together is that the resulting binary numbers can get quite large; similarly, the result of digital EQ (being the adding back in of delayed and multiplied sample values to the original data stream) is also that larger numbers are produced. Although the windows of any DSP system on the analogue world (the converters) are limited to 16 or 18 bit accuracy, internal data may have considerably longer word-lengths than this because of the effects of mathematical manipulation. This is what is meant when a manufacturer quotes 24 bit or 32 bit accuracy in a digital mixer. If sound quality is not to be impaired in the truncation of internal samples from this length to 16 bits for conversion, various intelligent rounding techniques together with the use of digital dither and oversampling may be used.

An interesting observation which arises from a



Yamaha's DMP7 incorporates effects and automation



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discussion of DSP is that audio products which use it will only really be limited in their power by the amount of processing capacity and the speed of operation. In the face of such flexibility, manufacturers will be in the difficult position of having to decide just where to stop in the development of new products, as it will be only too easy to carry on adding new features. Such developments imply that the audio industry will become very much like the computer industry, in that the latest DSP hardware will dictate the speed at which operations can be performed (and thus the sort of audio applications which are realistic in realtime) whilst audio designers will be market researchers or software engineers.

It would not be unreasonable to assume that the mixer as we know it will change considerably. There is already evidence of this in Yamaha's *DMP7*, in that the digital nature of the system has resulted in the incorporation of effects and automation as well as the traditional equalisation and faders. Likewise, some manufacturers which are researching the matter see the role of the mixer broadening in its scope to provide a wide range of facilities which had not previously been offered. This might spell the end of large racks of outboard processing equipment.

## Psycho-acoustic processing

Even more interesting than digital mixing is the potential that DSP offers for simulating real-life aural experiences which are entirely based on level and time differences between the ears. If it were possible to define a number of time delay and level-related templates which corresponded to particular aural situations, then it might be feasible to superimpose these onto dry-recorded audio material to convince the listener that he was actually experiencing the simulated situation. Such a suggestion is surprisingly not particularly far-fetched, as will be shown below.

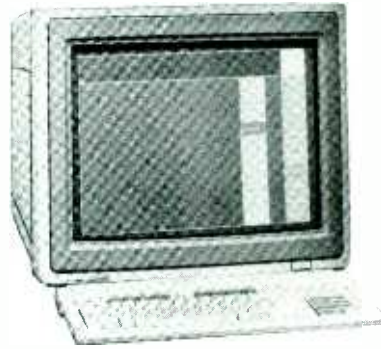
Psycho-acoustic research could play an important role in the development of DSP-based audio products. Few people have so far considered processing sound sources with this aspect of perception in mind, as it is one of the more esoteric and lesser-understood areas of audio, yet the potential is enormous. The amount of effort being invested in this area of research by certain European companies, in collaboration with universities, is quite surprising, and it is clear that some serious money is being poured into projects related to a whole new generation of audio processing.

So far, most of the aural effects that can be simulated by such systems require the listener to wear headphones, as the principles are based on those of binaural perception, but it can only be a matter of time before it becomes possible to compensate for the effects of loudspeakers and room. Using time delay and spectral shaping it is possible to position sounds anywhere around the head of the listener, and in any type of acoustic surrounding.

## Acoustic design consultancy

Looking at what has just been said about psycho-acoustic simulation it can be seen that such a processor would be the ideal tool for the acoustic designer. Wearing headphones and experimenting

with different types of wall-covering and shapes of room, the designer could know what a room was going to sound like before it was constructed! The software of the system would interpret the drawings of the room, the different surfaces, and their reflective characteristics in terms of delayed reflections at different times and amplitudes, as well as calculating the standing wave mode positions and amplitudes. The designer could position himself anywhere in the room and listen to the effect of changing a particular aspect of the construction or treatment with sound sources in different places. Again, we are simply talking



**The Creative Audio Processor from AKG**

about digital audio signals being delayed, multiplied and added to each other to achieve the desired effect; the limitation being in the number of these operations that can be carried out in a given period of time, as audio is essentially a realtime phenomenon.

It is possible to imagine the time when not only could an architect lead his client through a computer model of a new building to see what it would *look* like (this is already possible), he could also give an impression of what each room would *sound* like! The implications of changing a dimension or a surface covering could be considered both aurally and visually.

## A real product

As an example of the sort of work being done it is interesting to look at a commercial product, embodying a number of these principles. AKG's *Creative Audio Processor (CAP340M)* is based on a number of time delay modules and an audio processing computer, under control of a Hewlett Packard *HP-300*. The audio processor is a fast computer optimised for the crunching of audio data, handling it in 32-bit floating-point form at an instruction rate far higher than that of most modern desktop or mini computers. The user interface is graphic, with a mouse.

Presently, the product is at the 'what do you want to do with it?' stage, where virtually anything is possible and a number of suggestions are offered. The following are some examples of programmes currently used:

*Digital mixing:* A number of audio inputs are provided and the mixer panel can be user-configured to provide such functions as delay of each input (to align the arrivals from multiple microphones), elevation of the sound source (a psycho-acoustic effect) and position of source. The number of channels depends on the number of input and output modules chosen, and also the amount of processing installed.

In very friendly fashion, the processing of each input can be adjusted not by entering numbers but by moving the positions of 'microphones' in



relation to the listening position using a mouse with the graphic display. These inputs are then filtered and delayed according to the effect of their position. Going further, it is possible to simulate the use of a co-incident or binaural pair by using spot microphones and delaying/filtering them according to the characteristics of the required pair at a particular point.

*Room simulation:* Dimensions of a virtual room may be entered, and the surface coverings of the room defined from a library of common materials. The room is then graphically displayed, and a sound source can be placed within the 'room' with a binaural 'microphone' positioned to listen to the effect of changes in sound source position or room characteristics.

## Methods and cost

With audio computers using DSP in such ways as those described above, the way in which operators and consultants work may be changed. The positioning of multiple microphones for a recording may be less important, and it may not be necessary to have four loudspeakers in the home to reproduce surround sound. The designer of a new concert hall may be more sure that it will sound as he intends, and he will be able to demonstrate this to people before it is too late.

Currently the cost of DSP hardware is high, and the cost of software is even higher. Many man-years are required to cover the sort of research required in audio processing, psycho-acoustics, and market requirements. It is likely to be the end of the century before DSP is widespread in the audio industry, as only then will the initial mistakes have been made and the cost of processing come down to a reasonable level. It will also take that long for companies to learn tricks of the trade.

One should not forget the Japanese in this, as they have already shown what is possible in terms of DSP at low cost (Yamaha *DMP-7* and Roland digital equalisers). These products indicate that large-scale products cannot be too far away, and without an unreachable price tag. □

# VCA'S INVESTIGATED PART ONE

Ben Duncan outlines where VCAs belong in the scheme of things, discusses their origins, and the circuit topologies adopted by competing VCA makers

While VCAs appear with increasing frequency inside pro-audio equipment, readable literature on the pros and cons of competing VCA techniques is so scarce and widely scattered, that few sound engineers (or equipment designers for that matter) have had time to thoroughly 'get their head around' the different approaches. Yet without some degree of technical insight and overview, users (let alone spectators!) are almost bound to develop irrational prejudices.

VCAs (Voltage Controlled Amplifiers) provide the electronic control gain and attenuation that's at the heart of most audio processors and all kinds of automation systems, remote-controlled faders, panners and equalisers. Still, casting a glance at Fig 1, there's more than one way to implement electronically controlled amplification and attenuation.

## The family

Looking at the right-hand branches of the evolutionary tree in Fig 1, the incentive to develop audio VCAs arose out of the limitations of VCRs, which are much older and simpler (in concept, if not in practice). Both kinds are related through ohms law: VCR is just a voltage controlled resistance.

On its own, a VCR provides attenuation alone, but placed in a feedback loop, it can just as easily control the gain of an amplifier. Implementing the variable resistance implies using one or other kind of FET, or an LDR. Over the dynamic range required of a fader, and assuming a potentiometric arrangement, both kinds of element have awkward, uncivilised non-linearities of the sort which can't be wholly overcome—even granted fairly convoluted support circuitry. Ever since workable VCA topologies were established (in the mid '70s) VCRs have been left to applications which aren't fussy about limited linearity and a restricted operating range, ie limiters and budget FX processors.

The branch below is old, but a smattering of new growth affirms it's still living. On it are motorised pots. Pots (potentiometers) and motors are both Victorian inventions. Hooking them up to late 20th century logical electronic control works, but to Marlowe, it doesn't seem so elegant.

In common with other artefacts of 19th century engineering, the combination is characterised by simplicity, no great regard for size, energy consumption, or mechanical noise. To most readers, the long-term disadvantages of pots and stepper motors won't need much spelling out. Computer disk drives are hardly a good advert. Less well known is that (supposedly) SOTA pot manufacturers are still unable to manufacture ganged stereo faders (whether rotary or linear) which maintain channel balance within  $\pm\frac{1}{2}$  dB over the 30 dB+ span of everyday monitoring SPLs. When it comes to souping-up mechanical components, even laser trim has its limits.

The tree is lopsided: its left side has just one main branch, which is young and bears many buds. The contents of this branch are fundamentally different. While the devices on the right hand branches exhibit essentially infinite resolution ('you can put it where you really want it'), the left branch is all about producing gain and attenuation changes in discrete steps. Even for relatively slow processes, like automated

faders, glitch-free gain changes demands near equal steps of below 1 dB. For a fader covering 70 dB, it calls for (at least) a 12 bit multiplying DAC. Dedicated digital attenuator ICs have existed for over a decade, but their performance is still regarded with some suspicion. In the realms of customised pro-audio and money-no-object domestic hi-fi, volume controls have been built from discrete FETs. Granted a great deal of logical ingenuity<sup>1</sup>, the number of FETs needed to switch through 70 dB in  $\frac{1}{2}$  dB increments is less than you'd imagine.

For remote EQ, the ear is less acute. In the world's first automatic tonal compensator<sup>1</sup>, dynamic increments as big as 5 dB aren't readily audible at certain audio frequencies. Twenty years after their inception, FET switches which don't go *blahht* (particularly when the wick's turned up), don't distort at high levels, don't raise the noise floor unacceptably and don't require convoluted circuitry to support the cancellation of resistance modulation, are still scarce—if they exist at all. Finally, in processors, where the rate of gain change required is commonly rated in dBs per mS, the requirement for glitch-free stepping is even more stringent. Did someone say zipper noise?

## Analogue Computing

Audio VCAs were originally contrived in the late '30s by Western Electric for the compressors and limiters needed for film dialogue recording and broadcast transmitters. Further developments occurred in the '40s and '50s, when VCAs were used for analogue computers, at a time when digital machines weren't the fastest way to solve multi-order differential equations for the trajectories of Inter-Continental Ballistic Missiles, or the problems of fluid mechanics posed by nuclear reactors and chemical plants.

Since then, analogue computers have grown and grown, except nobody calls them that any longer. They come under the heading 'Analogue Functions' or 'Instrumentation'. In the language of boffins who want to monitor industrial processes, VCAs are multipliers or dividers. They are analogue's way of carrying out computation. Couple one VCA to another, and you've built a

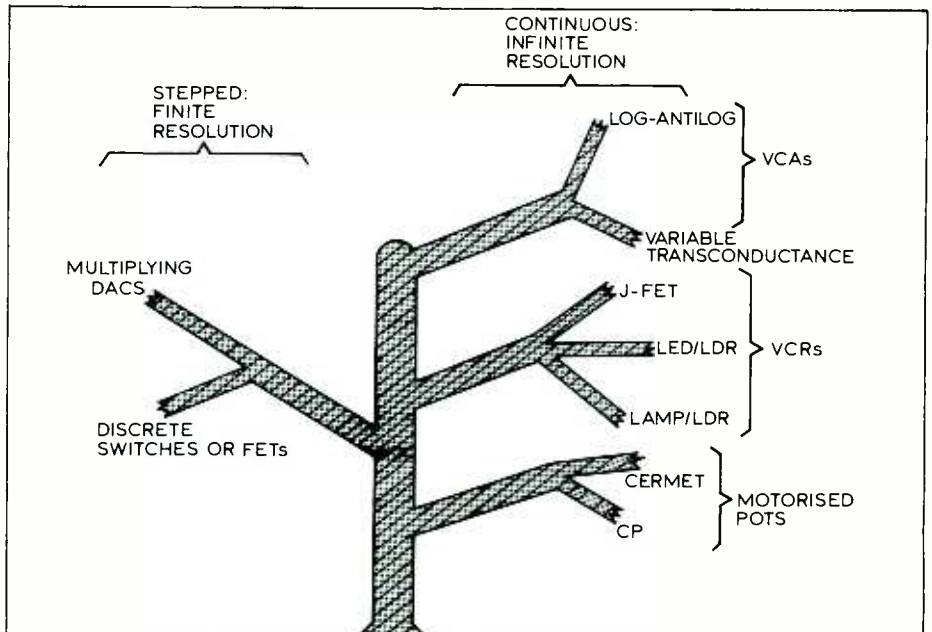


FIG 1: Tree of electronically-controlled gain and attenuation

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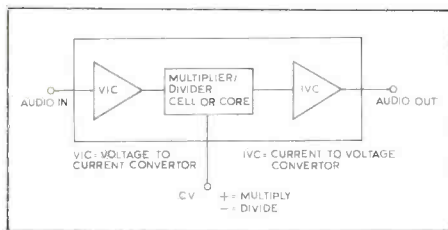
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◁ root extractor or exponentiator. Add some non-linear elements (a diode or two) and you have a circuit which will 'solve' the complex and simultaneous non-linear equations of nature in real time.

In audiospeak, multiplication or division of a signal are synonymous with gain or attenuation, or decibels being added or subtracted. It's a blessing for simplicity that practical VCAs can embrace both directions or 'Quadrants' to a lesser or greater extent. It's also handy that the acronym VCA can refer to both Amplification and Attenuation; though at least one VCA manufacturer prefers to differentiate the latter mode, calling it 'VCAU'.

In its broadest sense, a VCA is a black box with three ports (Fig 2). Two are everyday (audio) input and output. A voltage (or current) applied to the third port, labelled 'CV' acts to alter the audio through-gain and hence the output level. To save on brain-damage, it's convenient if a linear change in control voltage (or current) causes an equally linear change in the dB level at the output, eg 10 dB per volt. Again, for many audio



**FIG 2: VCA generic block schematic**

applications, the linearity of this relationship needs to be maintained over a range of some 3000x, or 70 dB. For others, 30 dB (30x) will suffice. Then for the kind of accuracy and repeatability that's desirable in up-market equipment, the ratio between DC control voltage and audio gain/attenuation will need to be tightly defined against the three Ts: temperature, time and manufacturing tolerance.

In the beginning, VCAs were built with tubes. The first solid-state circuits appeared in the early '60s. Using diodes and later FETs, they were

sometimes called 'vario-lossers'. Flushed with the success of the first IC op-amps in the late '60s, IC makers specialising in analogue, notably Burr-Brown, the aptly named Analog Devices and National Semiconductor, began to develop at first hybrid, and then monolithic 'analogue multiplier/divider' chips, using bipolar transistors. Within a few years—by the mid '70s—some of their products were approaching the kind of performance that would be acceptable to pro-audio, but prices were high. Around the same time, a handful of specialist audio VCA makers arrived. Each appeared waving a patent which annexed one of the bridges that lay between a multiplier suited to monitoring processes in a sausage factory, and one that was good for fading audio. Today, the world of Audio VCAs revolves around two kinds of circuit topology, produced in volume by five US manufacturers. Both kinds are traceable to techniques that were first figured out for analogue computation about half a century ago.

## Transconductance

The most rudimentary VCA one can build with transistors is just a simple development of the familiar differential amp, or 'long-tailed pair'. Looking into Fig 3, gain control is achieved by arranging for a voltage across 'CV' to vary the amount of (constant) current pulled through the amplifier transistors, TR1 and 2. The change in operating current directly affects their transconductance (current divided by voltage, or mA per volt = gm), hence the voltage gain,  $G$  recovered at A1's output ( $G = gm.RL$ ). This kind of VCA and others whose operation relies on changing the ratio of voltage-to-current transfer of active devices, are loosely known as OTAs (Operational Transconductance Amplifiers), or as transconductance VCAs (or multipliers). National Semiconductor's LM 3080 is a well known example of the genre.

As it stands, the circuit has a limited range. For DC, a linear change in transconductance is advertised over 3 decades (60 dB), but for audio where the need for dynamic range enters the picture, non-linearity sets in early. For less than 1% distortion, the audio input is limited to a few millivolts, essentially because variations in transconductance can only produce changes in voltage gain if the circuit is operated open-loop, ie without NFB. Mechanisms include a progressive increase in the  $V_{BE}$  in TR1 and 2 for tail currents above 1mA. The effect is only partially self-cancelling, hence the non-linearity. Distortion can be reduced for operation at normal line levels by passively attenuating the incoming audio (by around 40 dB), then recovering the level with an output amplifier. SNR suffers commensurately. Then, with high attenuation, slew rate becomes increasingly embarrassing as the active devices are starved of current. Instrumentation engineers refer to this circuit as a 'two quadrant multiplier'. This is to say that the audio or 'X input' has a bipolar capability (ie the signal can swing symmetrically), while the CV or 'Y input' is restricted to control voltages that are always positive (relative to the negative rail).

A more workable technique, employed in Nat Semi's LM 13700 (Fig 4), involves introducing a (nearly) constant bias current into each input node with a pair of diodes (D1,D2). Provided the diodes' geometry and temperature are similar to the devices in the OTA cell (Q4,5), their respective non-linearities are complementary, and partially cancel (Fig 5). With this *predistortion* method, drive levels can be raised by up to 15 dB ▷

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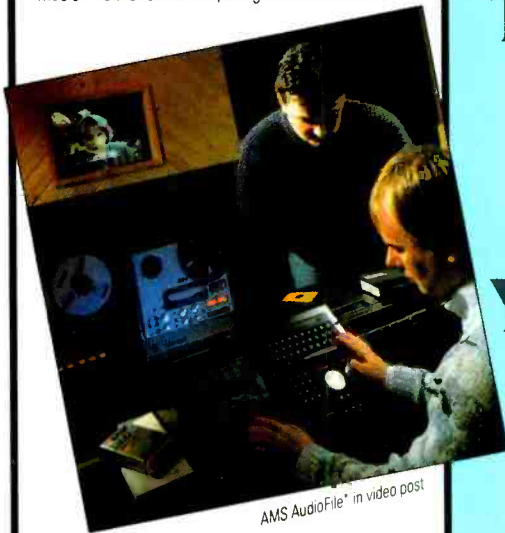
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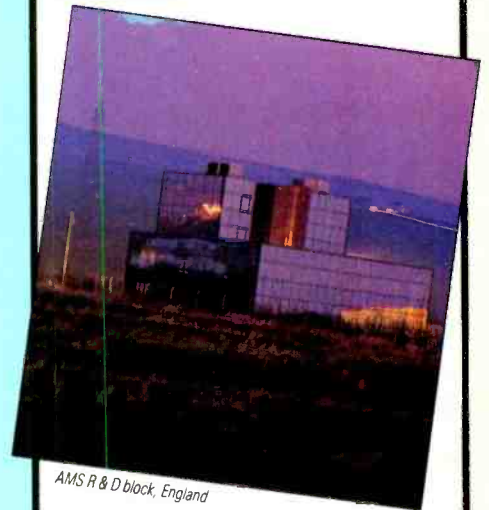
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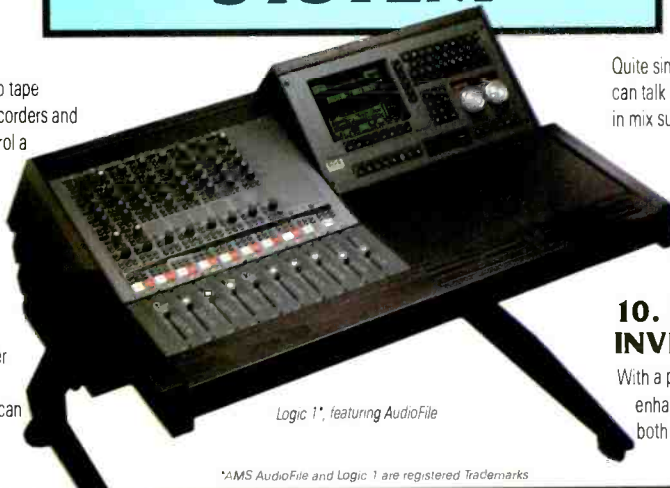
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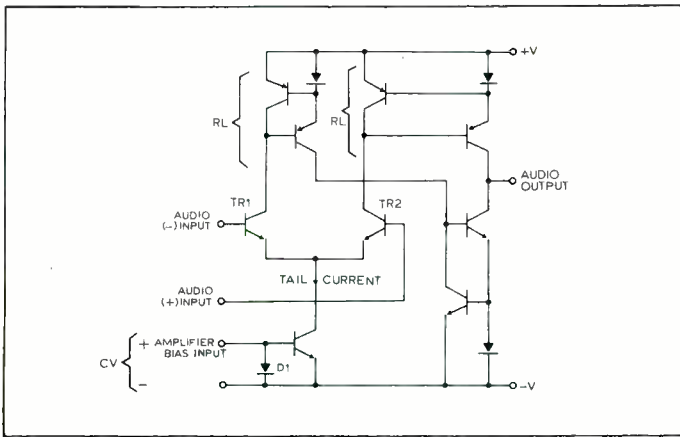
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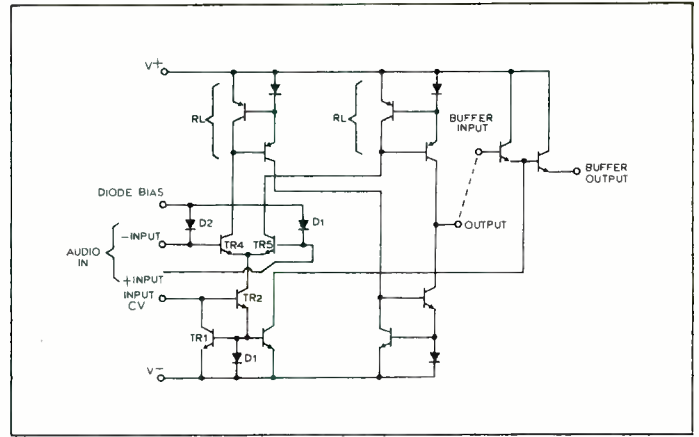


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**FIG 3: LM3080 operational transconductance amplifier**



**FIG 4: LM13700 operational transconductance amplifier with linearising diodes**

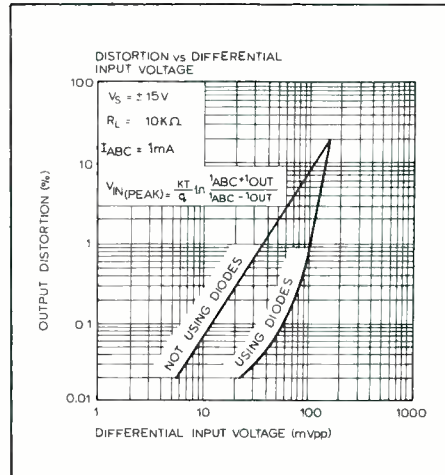
◁ for a given distortion level. SNR is improved in turn, but still remains around the level of cassette replay systems (circa -60 dB). And without input attenuation, fairly unacceptable levels of THD persists for signals over 70 mV (-20 dBu). All told, NSC's 3080, 13700 and related chips from RCA were a godsend for the synthesisers and consumer-grade audio of the '70s and early '80s, but not much else.

In higher performance circuits, based on Barry Gilbert's classic 'current-ratioing' (or 'current-steering') transconductance cell<sup>3</sup>, non-linearity is reduced by driving the active devices with current only. Figs 6 and 7 illustrate typical circuits. The immediate trade-offs are added complexity, and the need for multiple, matched transistors (T1 to T4). The key is to keep the ratio of the currents in the cell's transistor-pairs constant and equal to the corresponding pair of external currents under all conditions. In effect, the cell transistors need to be dynamically matched, a multi-dimensional headache. The linear input range is expanded with a mixed bag of techniques like offsetting, pre-distortion networks, cross-coupling, base stoppers and emitter degeneration. Achieving low THD then hinges on the cell transistors'  $H_{fe}$  being kept as constant as possible over a scale of collector currents that's as broad as the desired control range, ie  $10^3$  for 100 dB. Subject to design finesse, transconductance cells of this genre can exhibit respectable audio specifications. They are

particularly noted for wide bandwidth irrespective of gain or attenuation, and good isolation between audio (x) and the control signal (y).

In audio VCA parlance, good isolation is described as low 'control feedthrough'. The effect is a deviation from 0 v in the DC level at the VCA's output, usually referred to in millivolts. When defined with suitable reference to ZOL (ie

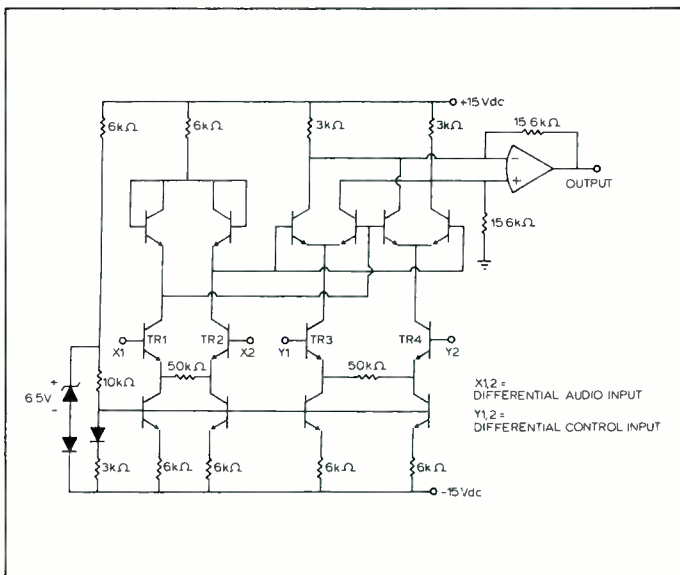
as minus so many dBs) it helps the designer identify VCAs which don't go thump, pop, or click when the gain shift is rapid, which can be important in processors, and is vital for automated muting, but less so for automated faders. In the debit column, current-ratioing transconductance VCAs are primarily attenuators or dividers. They have to be tricked into producing gain, and in turn, their performance suffers. Ultimately, their clean operating range is constrained by imperfections in the cell's transistors, notably finite base-emitter resistance,  $V_{BE}$  mismatch and differences in the saturation current of individual transistors, as well as limitations in the topology, leading to inadequate common-mode gain at the input<sup>4</sup>.



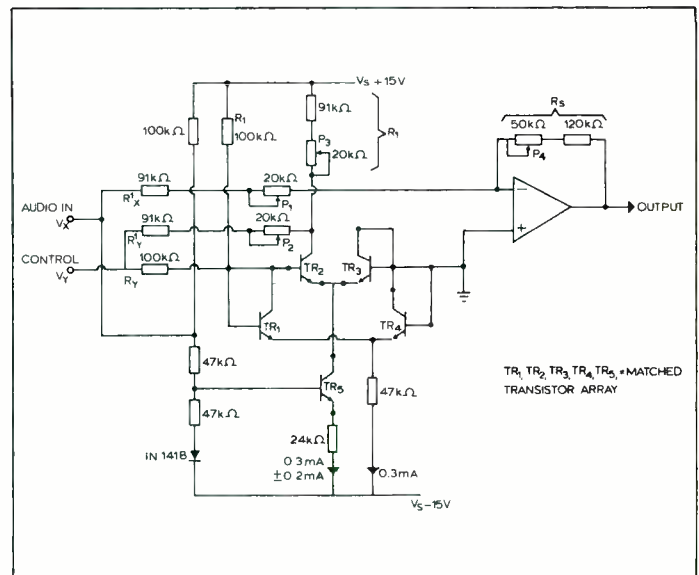
**FIG 5: Operational transconductance amplifier with and without predistortion**

## Log-antilog equation

Beyond variable transconductance cells, there are many other ways of implementing VCAs. Most of them are now obsolete, since audio isn't the only activity that can benefit from topologies that provide wide dynamic range, bandwidths beyond 20 kHz, and low distortion or 'error'. When these factors take precedence, there's only one other species in the race. The circuit in Fig 8 exploits the almost perfect logarithmic relationship between a bi-polar transistor's base-emitter



**FIG 6: Four-quadrant variable transconductance multiplier**



**FIG 7: Four-quadrant variable transconductance multiplier**

◁ voltage ( $V_{BE}$ ) and collector current ( $I_C$ ), plotted in Fig 9. Buffered by an op-amp, the combination acts as a 'log (arithmetic) convertor'. A 60 mV change in  $V_{BE}$  (in TR.1) will result in, or be caused by (it all depends on topology): a tenfold change in  $I_C$ . Now the going is ratiometric, the same tenfold change can be described as a 20 dB change in the recovered output voltage. So the intrinsic scaling of the basic log circuit is 60 mV/20 dB or 3 mV per dB. The next piece of the jigsaw is illustrated in Fig. 10. Here, a logarithmic convertor has been combined with an anti-log convertor. With the control inputs V1 and V3 grounded, audio appearing at input V2 appears unchanged at the output. Sounds NBG, eh?

It all begins to make sense once it's recalled that adding and subtracting logs is equivalent to multiplication and division. And that with analogue electronics, addition and subtraction are child's play. When a control signal is applied to inputs V1 or V3, it's added to the logged or anti-logged signal emerging from T2 or T4, to produce a decrease or increase in gain respectively. Unity gain occurs when the audio input and output currents are equal, ie log of 1=0. The concise formula for the log-antilog VCA can now be written: (i) convert the audio and control voltages into logarithmic and linear currents respectively; (ii) combine them; (iii) anti-log the nett quantity; (iv) reconvert the signal into a voltage. The basic log-antilog core (T2, 4) is unipolar, ie operates in one quadrant only. The complementary control ports provide basic two quadrant operation. In other words, the basic log-antilog VCA offers both gain and attenuation, but as it stands, it can't handle bidirectional input signals, ie audio. As we'll see next month, this is one of the problems

that log-antilog VCA pioneers Blackmer and Buff set out to conquer.

Compared to the current-ratioing transconductance species, the log-antilog VCA is adept at providing gain as well as attenuation. Another bonus is the control port's natural decilinear relationship of 1 dB per 3 mV change in  $V_{BE}$ . In comparison, the control port law of transconductance VCAs is intrinsically exponential. However, as temperature changes, the log-antilog VCA develops a cumulative but entirely predictable error of +0.3% per +°C. Added to this, there's a highly variable error of 2.2 mV per °C, dependent on the temperature coefficient of the core transistors' base-emitter junctions, known as 'bulk offset voltage'. However, provided bulk offset is identical in all the core transistors, it will be cancelled by the reciprocal log-antilog action. Further, any deviations in the logarithmic relationship between  $V_{be}$  and  $I_C$  will result in harmonic distortion. Overall, low distortion depends on mutual

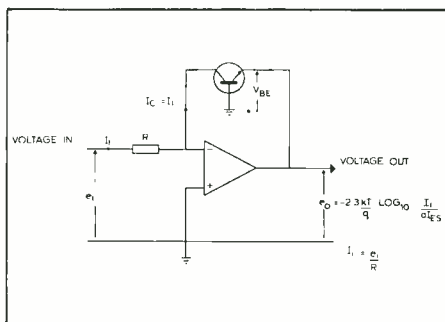


FIG 8: Log amplifier, transdiode configuration

matching of 2, 4 or 8 core transistors for log-conformance. Needless to say, the logarithmic characteristic gets progressively warped at extremes of the current scale. When the VCA gain is unity, mismatches in the log and anti-log transistors are self-cancelling. But with ascending gain or attenuation, distortion cancellation is progressively disorganised, and 'logging error' distortion reappears. The log-antilog VCA's control-feedthrough is potentially higher and the bandwidth, while ample for audio, does vary with gain setting.

In part 2, Ben Duncan describes how the circuit topologies just described are employed and refined in nine examples of modern VCA technology, including the products of the OEM VCA makers, whose chips populate the majority of pro-audio processors and consoles. □

#### Technical definitions and abbreviations

Cell	Active heart of a variable transconductance VCA.
Core	Active heart of a log-antilog VCA.
DNR	Dynamic Range.
$H_{FE}$	Current gain in a bipolar transistor.
$I_C$	Collector current (in a bipolar transistor).
LDR	Light Dependent Resistor (usually a Cadmium Sulphide cell).
NFB	Negative Feedback.
SNR	Signal to Noise Ratio.
SOTA	State Of The Art.
$V_{BE}$	Base-Emitter voltage of a bipolar transistor.
ZOL	Zero Operating Level, eg. +4dBu.
$H_{fe}$ , $V_{be}$	The lower case letters refer to incremental ('small signal') changes in these quantities.

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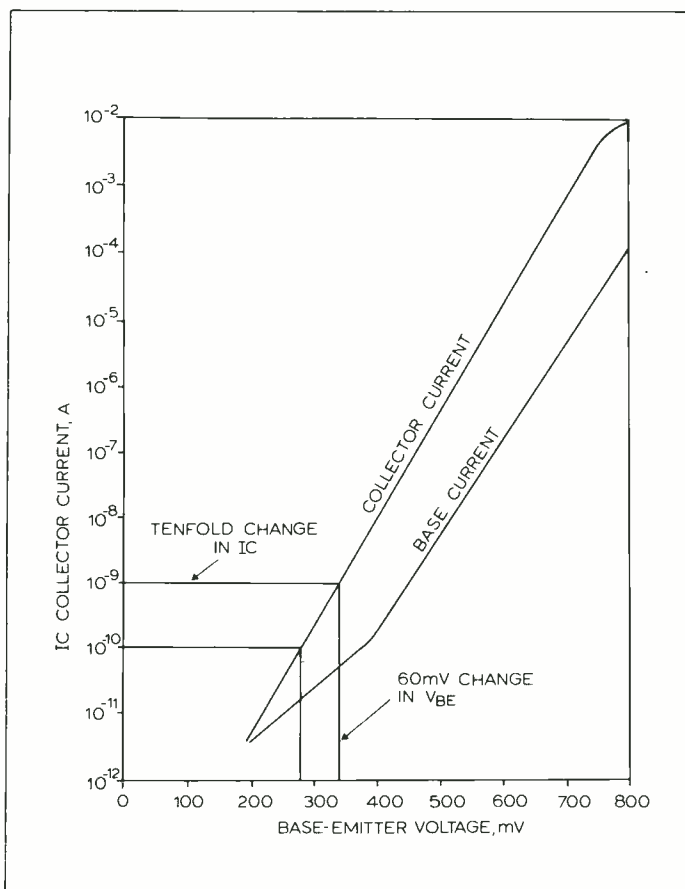


FIG 9: Collector and base current as a function of base-emitter forward bias with zero collector-base voltage

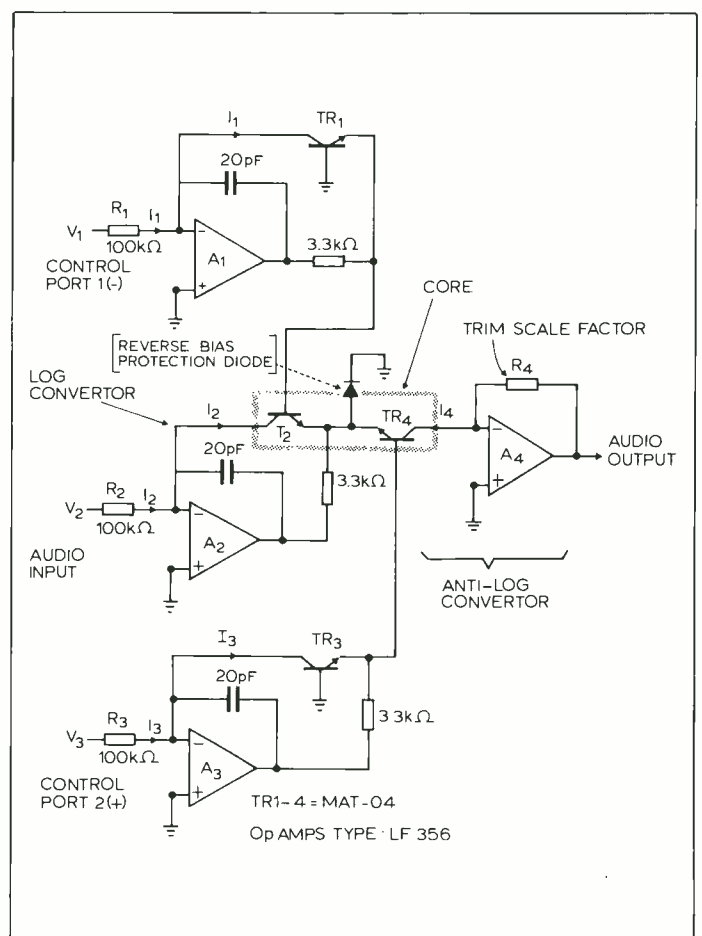
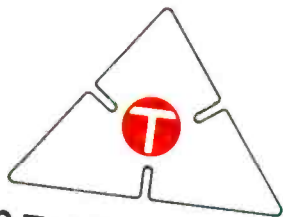


FIG 10: Log antilog multiplier/divider



STUDIO M25

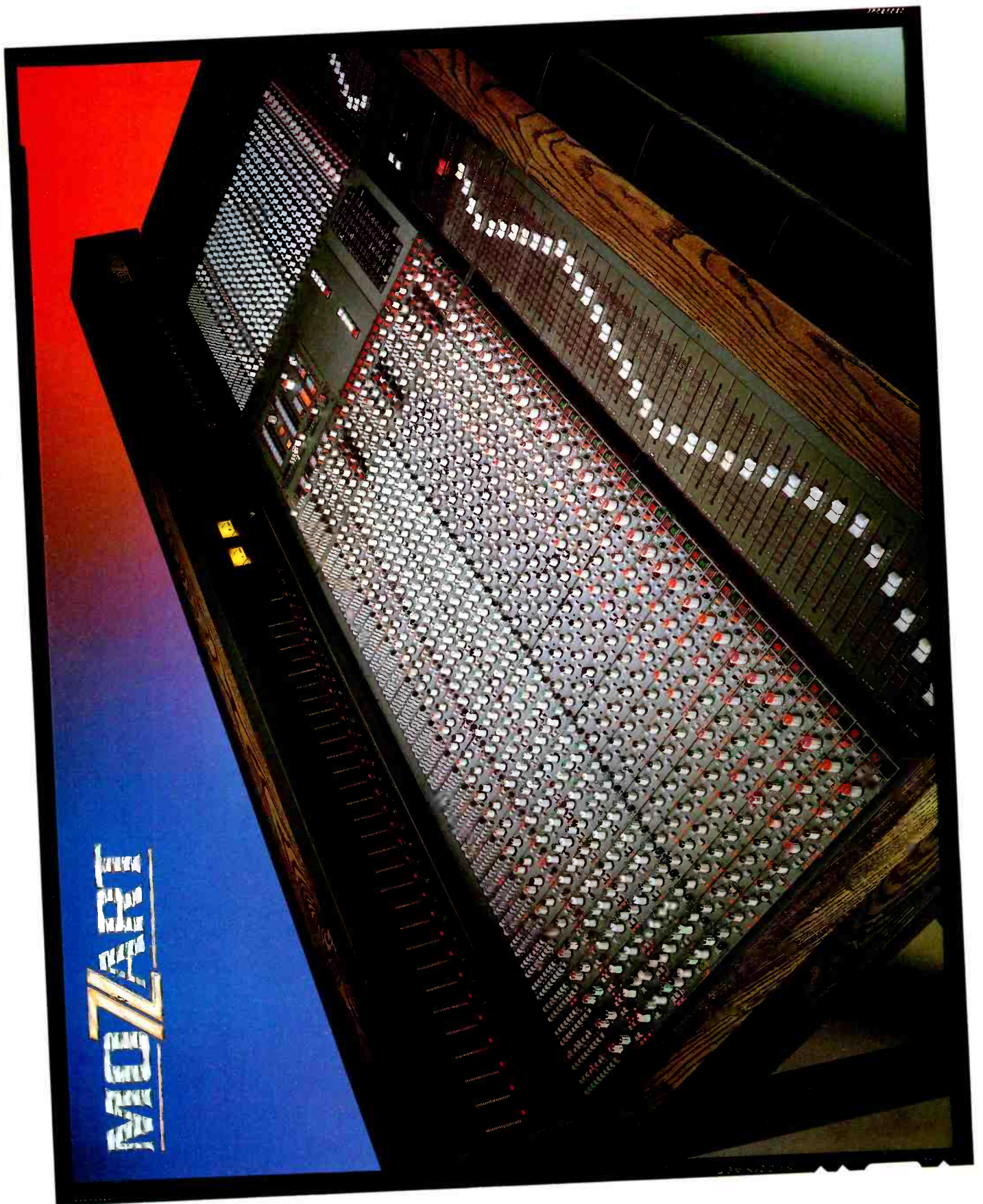
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# WHAT ARE WE MEASURING?

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Recent discussion on the ear's range of hearing throws some question over the choice of sampling rate for digital recording. Martin Russ considers the '7 kHz problem' at which point the ear can detect the difference between a squarewave and a sinewave

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One of the most interesting discussions which arose at the 1988 Digital Information Exchange concerned the range of hearing of the human ear. The choice of sampling rate for CDs and DAT was felt by some people to be too low and a higher rate was proposed as a means of accurately capturing the so-called 'superharmonics' of audio signals. Part of the justification for this was based upon the apparent audible difference between a 7 kHz sinewave and a 7 kHz squarewave. The first component of the squarewave above the fundamental is the third harmonic at a frequency of 21 kHz—well above the usually stated range of human hearing. Because it is apparently possible to hear a difference between the square and the sinewave, this was put forward as a proof that the ear is capable of discerning tones higher than 20 kHz—and thus the normal digital sampling rate of 44.1 kHz was put into question.

Such an argument polarises the protagonists into two opposing camps. Electronics engineers will probably accept the published data about the ear and so reject the idea that such 'superharmonics' exist, while audio engineers are confident that there is something different about a digitally coded signal and more specifically, that it is not easily expressed in terms of THD, SNR or any other common measure of performance. This article will look at the '7 kHz problem' mentioned above and see if it does offer any indication as to the actual frequency response of the human ear. It will not discuss the human ear and its method of operation but will look at the physics and electronics aspects of the problem, more within the author's sphere of knowledge.

## The problem

Can you hear the difference between a 7 kHz sinewave and a 7 kHz squarewave? More specifically, is the ear capable of hearing the 21 kHz component of the squarewave? In order to answer this we need to look in detail at exactly what the two sound sources will actually look like, rather than make assumptions about them.

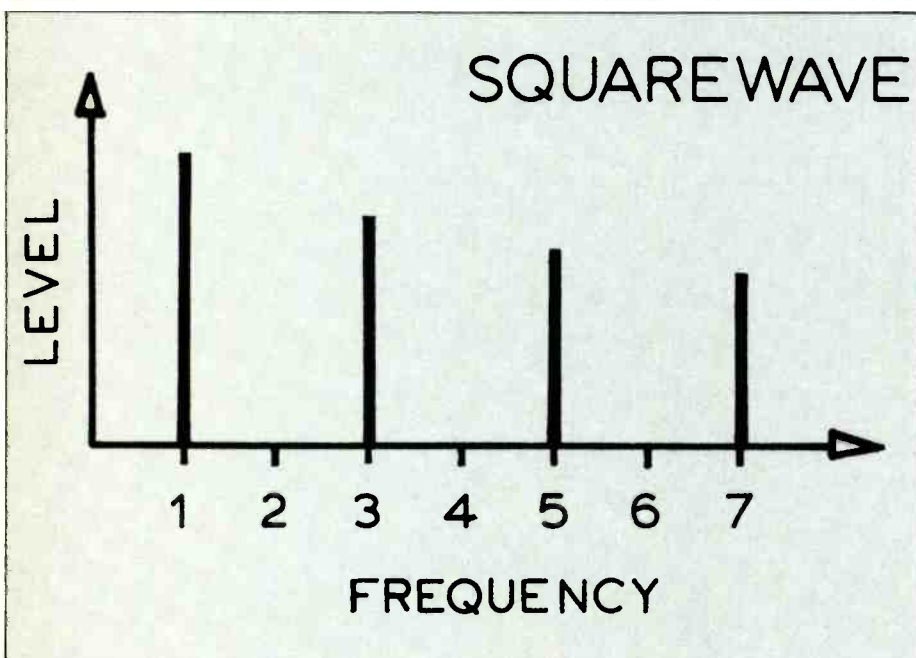
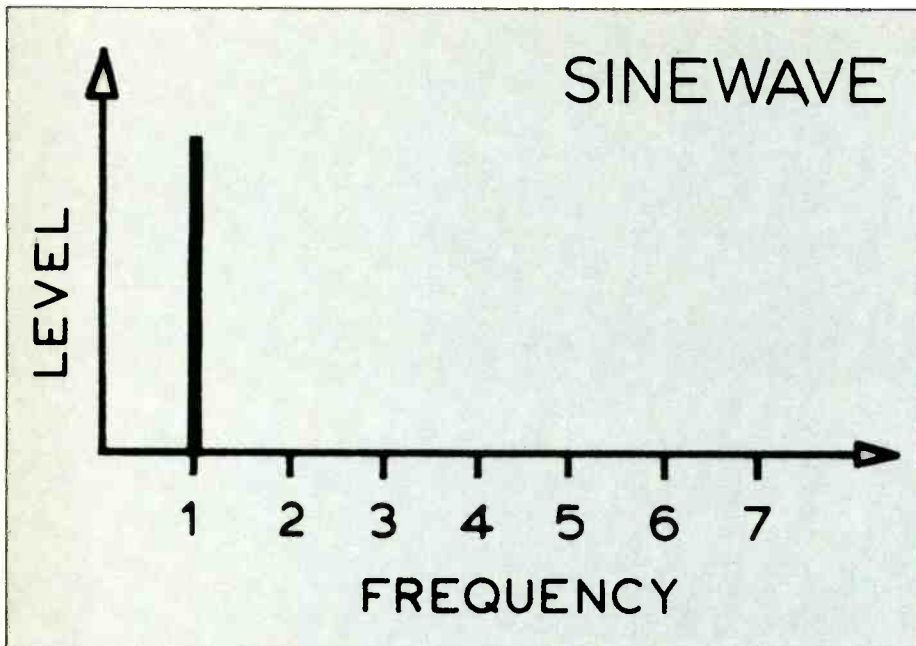
The sinewave seems simple enough—a single frequency at a specified level. Sinewaves are in common use for aligning instruments in many laboratories and studios, and are often referred to as a 'pure' tone. Unfortunately the actuality is rather different from the theory. A typical sinewave will contain noise, other harmonics and will have some frequency variation. Noise is a fundamental limitation on any physical system—for exactly the same reasons that mixing desks have a noise floor, so the sinewave signal will also have an equivalent noise floor. Other harmonics are often present in sinewaves because of the method of generation—filtering and shaping a square or triangular waveform may remove most of the frequencies above the fundamental but only very expensive and sophisticated sinewave sources manage to get all this additional 'clutter' below the noise level. The frequency stability of a sinewave is also limited by the method of generation—and again high performance is related to high cost.

Verifying a sinewave source can also be a problem. Connecting a typical sinewave into a spectrum analyser will probably show only a single frequency but this depends on the noise floor of the analyser, since if it is higher than

that of the sinewave source, then any harmonics will be masked by the analyser noise. Any distortion in the input stage of the analyser will appear as extra harmonics in the sinewave, and so the presence of harmonics on the display might not accurately reflect the true harmonic content of the sinewave. Measuring the frequency stability of the sinewave source requires an accurate timer—at which point the same sort of uncertainty problems come forward again.

The squarewave is also conceptually simple—a waveform with two states that occur for half the time. Squarewaves are commonly found in digital equipment and form a useful source for testing the response of loudspeakers. The problem with squarewaves is that they are impossible to achieve. A true squarewave has equal time periods for the two states and takes no time at all to change between the states. All real-world squarewaves take a finite time to move between the two states and so are really trapezoid waveforms. The slope between the two states and the ratio between the two times (the duty cycle) both affect the harmonic content of the squarewave—most importantly, they can affect the presence or absence of the second harmonic.

The second harmonic for a 7 kHz squarewave is at 14 kHz, and is present when the ratio between the two states is not exactly one to one and also when the time taken to change states is greater than zero. You can hear the effect on any sound synthesiser that provides control over the duty cycle of the rectangular waveform. As you alter the duty cycle towards 50% you can hear the second harmonic (an octave above the fundamental) drop in amplitude and almost



disappear as you pass through the 50% point. The notch is quite sharp and only slight variations in the duty cycle can cause significant amounts of the second harmonic to be in the signal. The second harmonic is important because although the 21 kHz third harmonic might reasonably be felt to be outside the normal hearing range, the 14 kHz second harmonic should certainly be detectable by most listeners.

Verifying the harmonic purity of the squarewave using a spectrum analyser has similar problems to those with the sinewave—the analyser distortion can contribute to the harmonic content. Equally the noise floor of the analyser can mask a second harmonic, which is present in the squarewave but below the noise of the analyser. Even if the second harmonic is below the noise level in the original signal it has a fixed level and frequency, as opposed to the surrounding noise—perhaps providing enough clues for the ear to detect it—much as radio amateurs are able to work with Morse transmissions with a negative signal to noise ratio: the time correlation gives away the presence of the tone in the noise. This effect also occurs with the sinewave, so averaging of the

spectrum display is needed to enhance the correlated frequencies and suppress the noise components.

We seem to have an escalating set of requirements for our basic equipment. The two sound sources need to provide a sinewave and squarewave with as near perfect spectral purity as possible and to verify this we need a spectrum analyser whose performance is as good if not better than the waveform generators. Once satisfied that the raw sounds are as near perfect as possible, the next stage is to couple them to the listener.

## Transmission

In order to hear the sinewave and the squarewave, they need to be amplified and converted into sound waves suitable for reception by the human ear. The amplifier must not add any distortion to the sounds as this would add harmonics thereby removing some of the intrinsic differences—the second and third harmonics of the 7 kHz fundamental being the most important in this case. Obviously a high quality amplifier is

needed, with low noise and distortion.

Note that we are not considering using a digital transmission medium as an intermediate stage—I am staying in the analogue domain for this discussion. Any digital coding or processing of the signals would introduce bandwidth limitations, changes in noise floor and distortions, which would further degrade the purity of the waveforms.

More problematical than the amplifier is the loudspeaker to which the amplified signals are connected. No speaker is perfect—a typical high-quality loudspeaker has a distortion of several percent—and so this will upset the carefully generated 'pure' waveforms. The resulting sinewave will contain harmonics other than just the fundamental, and the squarewave will contain harmonics other than the fundamental and odd harmonics. The distorted sound waves will then be detected by the listener's ear and analysed. The distortion is particularly unfortunate since the missing second harmonic, which should be absent from each waveform, could now be present in both. The task of verifying the detection of the 21 kHz component has been negated by the lack of certainty as to the presence or absence of any lower harmonics—in particular the 14 kHz second harmonic.

Despite careful attention to detail, we have fallen at the last hurdle! The sine and squarewaves, having been checked rigorously for correct harmonic content, have been corrupted by the loudspeaker. With any significant distortion present, we cannot verify that the sinewave contains just the fundamental and the squarewave no second harmonic, and so it looks as though we cannot prove anything with the experiment, since we could be proving that the ear is capable of detecting the 14 kHz second harmonic.

## The experiment

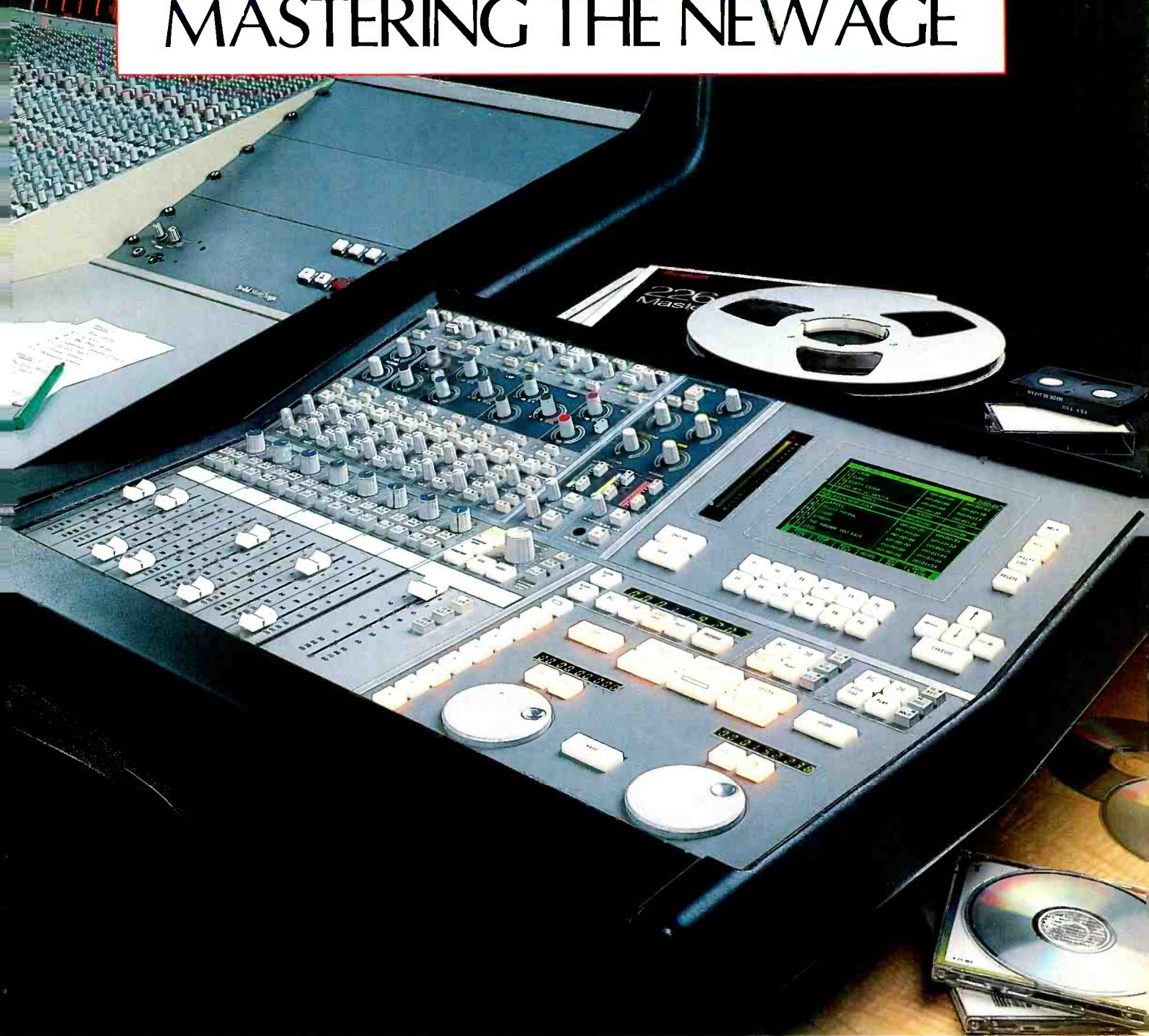
To confirm the above, I carried out some tests on an informal basis. I used standard laboratory frequency synthesiser sources for the sine and squarewaves, using a high-quality loudspeaker and amplifier. All three subjects tested were able to reliably detect the difference between 'sine' and 'square'-waves up to 9 or 10 kHz. One of the subjects commented that detecting the difference was easier at the higher frequencies! Time and resources did not allow more formal testing under controlled conditions but the results were consistent and repeatable.

## Conclusion

I must admit that I was originally sceptical about being able to detect a difference between a sinewave and a squarewave at 7 kHz. The points described above convinced me that the problems were more to do with what was being measured by the experiment. Assuming that the source and amplification are as near perfect as they can be made, then the listener is probably detecting the difference in the distortion of the loudspeaker for the two signals. Using anything less than ideal signals under perfect experimental conditions would muddy the water even more. I conclude from this that the experiment as described does not confirm or deny the hypothesis that the ear can hear the third harmonic of a 7 kHz squarewave. □

*Acknowledgement is made to the Director of Research and Technology of British Telecom for permission to make use of the information contained in this paper.*

# MASTERING THE NEW AGE



## 01 DIGITAL PRODUCTION CENTRE

Mastering and editing are as important to the quality of a record as the final mix. With the emergence of CD as the dominant consumer software medium, a new approach is needed to bring the quality of service traditionally provided by the vinyl disc mastering room to the digital domain.

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The studio was dark except for the glow of a small table lamp showing through the double-glazed window from the office in the loft above. The blonde could be seen in silhouette from the studio floor. As the engineers and musicians filed in for their late evening session, the usual banter about Stan's good luck and sexual prowess began again. Up in the loft, the blonde was teasing Stan. A new girlfriend, she enjoyed his ownership of a major studio in an industry that made the music she loved. "So, you like your new friend?"

Stan could only gargle, "Yes."

The blonde continued her tease, "Well, you have quite a package here. I'm wearing a leather skirt and a silk blouse."

She picked up Stan's pliant hand and moved it across her blouse and down her skirt. Stan was reduced to virtual speechlessness.

"Now, feel the nylon of my slip and the nylon taffeta lining of my skirt." She guided Stan's hand there, as well. "Feel my nylon stockings, too."

Stan complied.

"My skin is smoother and softer than all of my pretty clothes. Wouldn't you like to feel that, sooner than later?" The syllables dripped like honey.

Stan felt that there was a time and place for everything and this surely was not it. Not with a session setting up downstairs. "Would you like to see the set up for the session down below," he asked.

"Is the Pope Polish?"

Her response made Stan flinch. "This woman will kill me but what a way to go," he thought. They drifted downstairs.

In the control room, she was irrepressible. She slithered across the deep carpet from console to recorder to signal processing rack. "She is really something," thought Stan: just the sound of her walking around made him nervous. "She has to see everything and touch everything," Stan thought. She was especially attracted to the lighted switches on the console output panel and the sampling rate cards with the blinking LEDs on their extenders in the front of the brand new 24-track digital recorder. She nearly tripped in her 3 inch heels and as Stan caught her, he realised he had to get her to dinner and then to his apartment. He really had to!

Several hours later Stan was reflecting on the evening. The phone rang. It was Jack Edgerton, his chief engineer. Stan was alarmed since at this time of night, Jack would have been called in from his home on City Island. Jack was indeed no longer home. Stan was already pulling on his coat as Jack perfunctorily explained the call. Stan hung the phone up after digesting Jack's dire explanation of the woes that had befallen the session in progress. He motioned to the supine form of the blonde, now fully dressed on the couch. The evening was over. He dropped her off at her house and sped to the studio, his driving of the black Porsche calling for all of Dr Feri Porsche's tricks that were built into the car.

"Look, Stan," said Jack Edgerton. "It's positively spooky. They had console output locked to the digital recorder. The logic lamps in the switches leave no room for miscomprehension. Yet the recorder was getting no signal. They sat down

## Martin Polon

ESD is not a new drug or an unpleasant disease but it can cause damage to your memories.

Comment from our US columnist

at the console and flicked the switches over and over until they finally got output. The console seems to be OK now. But the recorder sounds like a 10 bit digital 'truth box' used in AES lectures on sampling rates. It's really awful."

Stan thought for a minute. "We should be getting in the rest of this shipment tomorrow by truck. There will be spares on all the recorder cards. Ship the sampling cards back to the manufacturer."

Little did Stan realise that every card in the recorder would have to go back to the manufacturer. The recorder maker refused to accept responsibility for such complete damage. The large insurance company that Stan relied upon finally decided to send out an electronic damage consultant. Immediately upon arrival, the consultant took one look at the thick carpet in the control suite and muttered the word, "Synthetic." The card extenders were also eyed suspiciously. "Anyone around here wearing a lot of nylon and/or leather? High heels?" The consultant stopped to ponder the answers to his questions.

Stan cupped his head into his hands. The damage would cost many thousands of dollars to repair. All he could do was to repeat the name over and over again. "Gladys, Oh Gladys."

Well, boys and girls, here we are again with another of Mother Polon's famous fairy tales. What was it this time. Was Gladys a witch? Perhaps an East German agent on the run from MI5 with a secret weapon to destroy electronics? No, it would appear that Gladys was simply an extremely healthy young woman in fashionable attire who really wanted to be current. So current that she generated perhaps 25 amperes flow worth of 10,000 volts into all of the exposed cards on the new recorder being set up. What Gladys did was to rupture insulating oxide layers and vaporise deposited metal stripes of the IC chips used in the digital recorder. What Gladys also did was to change the logic states on certain console components: Electro Static Discharge. The big ESD strikes again. The FORCE was with Stan that night and this is one FORCE that you don't want with you, ever.

Hey, wait a minute. We're in the audio business. We're corn-fed boys who built our first

console in the garage behind the folk's house. We used 12AX7 tubes and Sowter transformers and power supplies with choke coils. The only thing that could stop our analogue consoles and tape recorders was a copper-sheathed slug from a Colt 45 and then only if you knew where to shoot! Where did all this space-age stuff come from? Welcome to the wonderful world of digital audio and computer electronics. A hearty 'howdy' to logic chips and computer ICs. And most of all, a big audio industry hello to the curse of ESD.

Basically, what is happening is that triboelectric effects, known more commonly as friction, cause your body to become charged when you walk across an insulated surface or move about in the insulating seat of your chair. Assuming you are wearing ordinary insulating shoes, your capacitance will be somewhere between 100 pF to 500 pF. Every action you take will affect the electrical charge you develop. Your charge will consist of a stroll to the water cooler on an insulating rug, a shrug of your shoulders if your clothing acts to further the charge, a shift on an insulated seat at your desk, etc. The amount of ionisation of the air in your environment and the humidity in your environment will impact the development of the charge. The charge represents a change in your body's electrical potential with reference to ground. Your movements simply convert mechanical energy to electrical energy. Your body acts as a capacitor to store that developed energy.

A stored potential consists of small currents in the range of nanoamperes that flow in a matter of seconds to charge your body's capacitance. The voltage can range from five to 40 kilovolts. The 40 kilovolt figure is considered the maximum because a corona will develop around your body as the electrical field gradients reach a point large enough to conduct through air. That usually creates a condition for at least partial discharge. And to be absolutely clear on this point, there is nothing to say that women are any more likely to cause ESD than men. However, female fashion does create an environment enhanced for the collection of electrical potential. Women's shoes are especially significant in giving women a higher average capacitance than that of men.

The trouble comes when you change your potential in respect to ground by grounding yourself or by touching an object that is at a different potential to ground. Your charge stored in your body capacitance is changed with little or virtually no resistance or inductance to limit current flow. The change in your stored charge takes place rather rapidly, therefore a relatively large peak current can be generated.

Research seems to indicate that discharge currents develop to a peak in less than 100 picoseconds and perhaps as fast as 30 picoseconds. In plain language, 'faster than you can blink an eye'. Peak currents will range from about half an ampere to more than 30 amperes. That means that a casual touch of a piece of equipment can place anywhere from five to 40 thousand volts with a current flow of half to 30-odd amperes. In effect, small currents charge quite small capacitances to high voltages. Destructively large currents flow when the small



# WORLD SERIES

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**Bob Clearmountain**

今や私には空気のような存在である。——時には、音の発想の手足となりあるときは、複雑な要求にも応えてくれ、いや、もしかしたら求めた以上のものを与えてくれるかもしれない可能性を秘めている。今や私の仕事空間には必要不可欠なコンソールである。

内沼映二 **Eiji Uchinuma**



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capacitance is fired by grounding.

Speaking of environments, today's recording studio and most assuredly tomorrow's studio use a broad range of computer products never before seen in audio recording. In the old days, we used devices that offered battleship construction with virtual iron-clad reliability. In fact, vacuum tube technology analogue audio equipment made the term 'iron-clad' an accurate description rather than a clever turn of words. ESD did exist but was not very well understood. It is interesting that ESD is an almost invisible killer. It does its damage in ways that cause equipment to fail days, weeks and months after the initial damage takes place. In today's world of computer controlled and computer operated audio hardware,

able to diffuse and discharge ESD harmlessly.

That requires not only equipment designers familiar with ESD but the use of ESD simulators to destructively test new products. This testing should include exposing the product to the range of expected high voltages and high ampere current flows that are characteristic of an ESD discharge. It cannot be stressed how important design parameters become both in terms of ESD protection and the concomitant problem of AC line spikes.

The use of conductive tiles is one of the tricks that one finds most frequently in computer rooms. Yet the modern recording studio as we enter the 1990s is becoming nothing so much as a computer room. What we find on the floor, however, is

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## One of the most difficult problems in dealing with ESD in the studio or broadcast environment is the way that it strikes after the fact. A digital recorder might soldier on for several months after an ESD strike only to succumb catastrophically and dramatically right in the middle of an important recording session

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the threat is primarily damage to complex integrated circuits (ICs) such as very large scale integrated (VLSI) chips and logic chips. Insulating oxide layers are ruptured, deposited metal stripes are vaporised and lead/circuit junctions are weakened to name a few of the changes caused by ESD. In today's elaborate products, ESD really is a killer.

One of the most difficult problems in dealing with ESD in the studio or broadcast environment is the way that it strikes after the fact. A digital recorder might soldier on for several months after an ESD strike only to succumb catastrophically and dramatically right in the middle of an important recording session. There will be no way for studio maintenance staff to surmise the cause of the failure after the fact. Factory maintenance people will also be at a loss for an explanation, since chips do not lend themselves to elaborate post mortems. One specific problem in identifying ESD problems is the similarity between an ESD discharge and a lightning strike carried down the power line or similar high voltage AC line phenomenon. A learning experience must take place so that studio staffers will learn the same lessons computer workers learned a long time ago. The world's second fastest fuse is a transistor; the fastest fuse is an IC chip, which is after all a series of transistors on a chip. The point is, ESD is with us every day. In fact, ESD is us.

In theory, the audio equipment maker has the obligation to manufacture products that meet two criteria. First the product must be able to be manufactured without significant ESD damage from the factory. That means the use of grounded conductive mats at the various manufacturing stations, conductive footwear for employees, grounding wrist straps for anyone who handles the circuit boards, humidity control devices and ionisers. The second requirement is that the products themselves act as self-contained 'tanks'

carpeting—which may be the worst possible flooring material to deal with an ESD problem. It is by definition an insulating material—it serves to create increased potential as people pass over it and it insulates from ground. The use of conductive flooring, whether tiles or some other material, serves to create a common potential close to ground for all components in a mixing suite. Ground wiring does help when it places all components at an absolute potential but the presence of 15 kV at 20 amps will make stray inductances in what is perceived as a direct short to ground look like an open circuit during ESD discharge.

**E**quipment maintenance of ESD-damageable units requires a whole new set of skills. The first thing to go is the rather rampant use of extender cards to speed up both alignment and troubleshooting of complex digital recorders, digital editing stations and mixing consoles. One experienced repair technician who is ESD-wise contemplated the changes as follows: "It is like the system of flood gates the London Transport put into the underground during World War II for all the tubes that ran under or near the Thames. As long as these gates were in place, even a bomb breach would not flood the system. But everything had to remain closed during the raid. The system had to be kept very tight.

"The same with extender cards on vulnerable products using digital or computer technology. Open the enclosure and you allow ESD discharge to travel through the machine."

When products are actually 'on the bench' for repair, the handling of critical IC devices must be done to minimise exposure to ESD. Aside from grounding mats, shoes and wrist straps, careful use of insulating bags, chip carriers and circuit board carriers is required. The technique and

tools used for IC insertion or removal are specific and chip protocol must be followed to the letter.

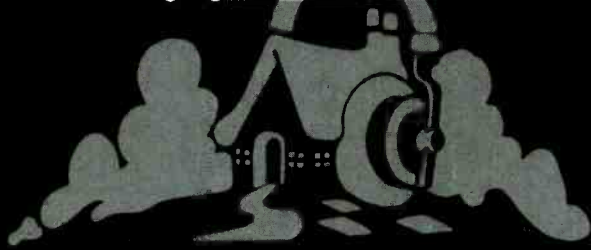
Yet direct or as we have seen, somewhat indirect catastrophic damage is not the only threat posed by ESD. During a recording session or during an editing session, the master recording could be damaged by the entry of electrical noise caused by ESD. It cannot be stressed how difficult it is to diagnose ESD damage or interference. Many of the mysterious problems that befall modern equipment or modern recordings can be traced back to an ESD discharge. Due to the extreme speed of discharge waveforms, the electrical interference produced assumes the dimensions of high frequency energy. Random inductances in grounding between units, discontinuous grounding assemblies, improperly designed ground planes, etc. are all capable of admitting sizeable amounts of ESD as noise energy if not as high current discharge. And the most difficult part of all this is that when the tape is played back, the 'glitch' will not identify itself as ESD. It will just be a mysterious burst of noise that ruined one take.

The least manageable problem with ESD is its mysterious nature. Staff frequently refuse to believe that "all the silly precautions" are necessary. Employees frequently feel that the whole thing is a waste of time and become quite cavalier about ESD protection. Studio management frequently does not have the extra time or energy to check up on the ESD safety programmes. Conductive mats need to be inspected periodically as do wrist straps for positive continuity to ground. The use, monitoring and maintenance of equipment and systems designed for static control must be an on-going process.

One manufacturing engineer frequently tells his favourite ESD story: "We had a product installed in a carpeted recording suite. There was one mixer who was the very height of fashion, if you know what I mean. This fellow had one particular pair of rather expensive loafers that he would wear infrequently. This product of ours was failing once a month like clockwork. We couldn't figure it out. We were eating all the costs. It was warranty when it went in and every time we fixed it the warranty clock started to tick again. We were replacing the same expensive ICs each time. After the second or third time, our director of engineering suspected ESD. We had the co-operation of the studio owner and we placed a stop motion camera in the ceiling. It turns out that once a month, this gorgeous young lady minister would come in to record some music for her radio show. The mixer was apparently in love because he was moving all over the place during her sessions. He was obviously showing off. That plus his special shoes was causing an ESD problem. Normally, he wore ordinary penny loafers that did not isolate him as much. When he mixed during the rest of the month, you never saw a guy more glued to his seat."

Bottom line on ESD. It is a problem that will be more and more common as 'iron-clad analogue' leaves the industry and computer and digital products begin to dominate. The problem is easily solved when appropriate precautions are taken. It is a problem that can become quite shocking if ignored! □

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# Fostex D-20

A technical report by Sam Wise on a new DAT cassette player with professional level facilities



The Fostex D-20 is the first DAT machine to provide the features that professional tape machine users have been accustomed to, including SMPTE timecode, varispeed, playback off tape while recording and drop-in (punch in) capability.

## First impressions

At first glance, the D-20 gives the appearance of one of the top line Revox or Studer table-top products, such as their CD or cassette players. Surely this must be intentional, giving the D-20 a

similar impression of quality. The livery is in shades of beige and grey, with red and green LED indicators and a fluorescent-type meter and tape time indicator. The unit has a professional feel to it and is obviously intended to reflect its title of Digital Master Recorder visually. The unit is supplied as standard with rackmount ears and takes up three rack units once the rubber feet are removed.

Internally the unit is well made in the typical Japanese fashion of multiple PCBs interconnected with flying leads. The unit is relatively easy to disassemble as later experience was to prove.

An IEC power connector is used. Internal

selection allows 240, 220 or 100 V operation. The US appears to have a separate model with 110 V operation.

The operating manual received was a photo copied draft but contained adequate information for proper machine operation. A full manual should be available by the time this review is published.

## Operation

The tape cassette is loaded much like a VHS video cassette, just shove it in and the transport swallows the cassette and loads it. A warning light tells you that LOAD is in operation. The adjacent EJECT button does just that. Basic operation is not a problem using the standard RECORD STOP, and PLAY controls. The FFWD and REWIND controls are multi-function. First push causes the transport to wind at 5x normal speed. A second push shifts to 100x normal speed. Thereafter the buttons toggle between these speeds; very handy with DAT, which tends to go like a rocket when winding. Near the centre of the front panel, there is a RECORD READY selection to be made before the machine can be placed on record. There are separate RECORD READY selectors for timecode and audio, though the two audio tracks must always be recorded together.

To the right of the READY controls are the monitor selectors, which are affected in their

## Manufacturer's specification

### Record replay characteristics and encoding to DAT standards

Quantisation: 16 bit linear

Dynamic Range: >90 dB (emphasis on, 1 kHz)

Frequency Response: 20 Hz to 20 kHz

Total Harmonic Distortion: <0.05%

Wow and flutter: below measurable limit

Crosstalk: >80 dB (20 Hz to 20 kHz)

Emphasis: switchable

### Input/Output

Line in: XLR x 2. Nominal level: +4 dBm,

max +28 dBm. Input impedance: 20 kΩ

balanced

Line out: XLR x 2. Nominal level: +4 dBm,

balanced

Monitor out: standard phone jack x 2

Headphone out: stereo phone jack x 1

Digital in/out: XLR, AES/EBU format

Timecode in/out: XLR. Nominal level: +4

dBm. Input Imp: 20 kΩ. Balanced,

SMPTE/EBU format

Ext-sync in: BNC, TTL level

Remote: flat cable 20 pin connector for parallel

interface (ie to Fostex 4030 or other)

Serial port: RS-422-A

Power supply: 240 V/220 V/100 VAC, 50/

60 Hz, 60 W

Dimensions: (whd) 482x150x472 mm/

19x5 7/8x18 1/2 inches

Weight: approx 15 kg/33 lb

Fostex Corp, 560-3 Miyazawacho, Akichima,

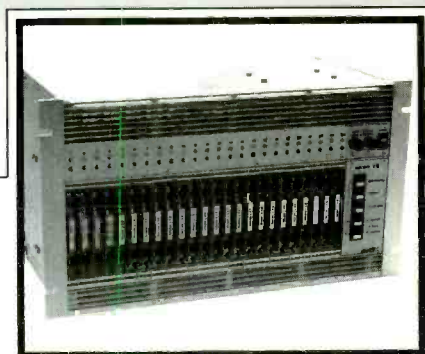
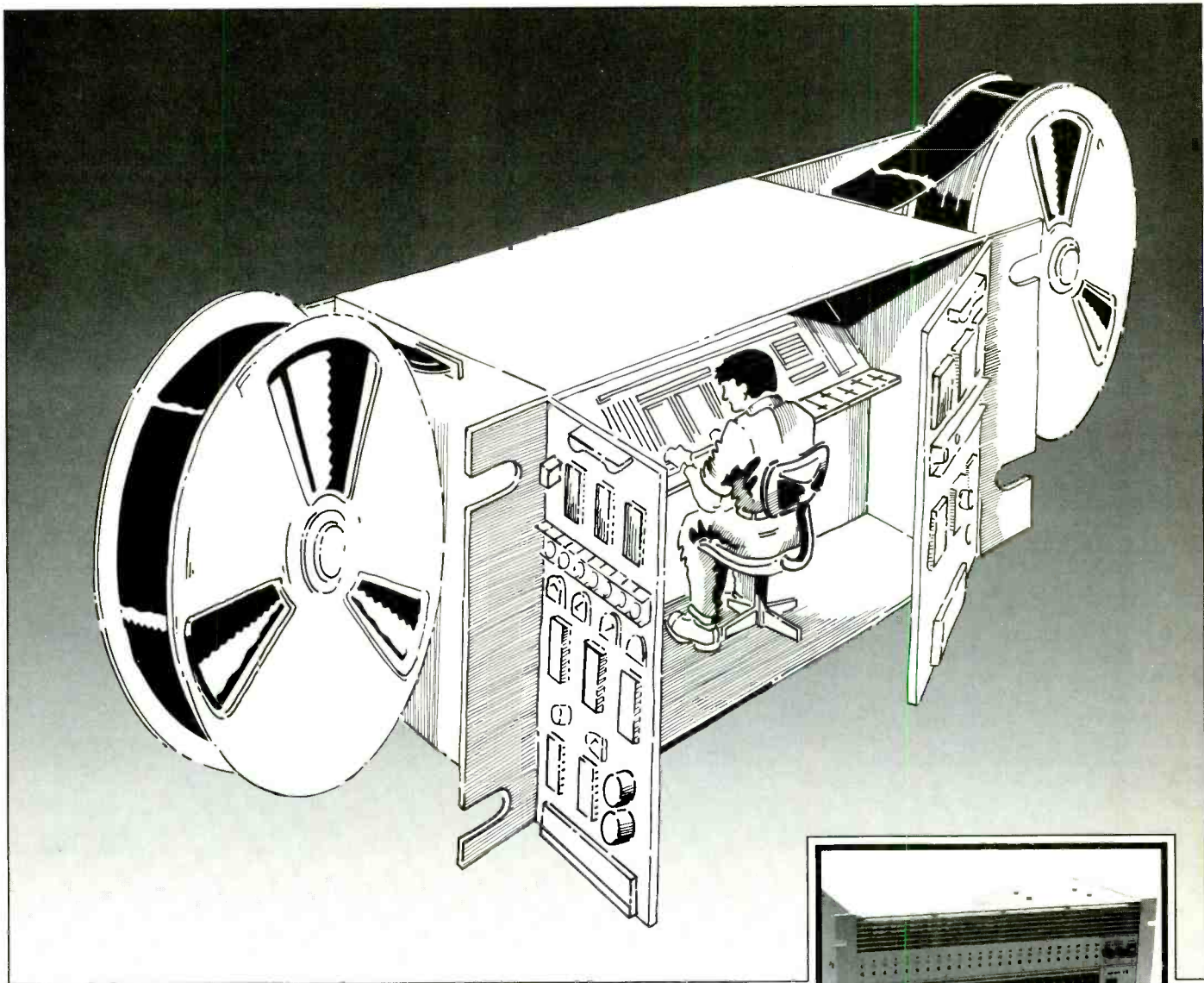
Tokyo, Japan.

UK: Harman Studio Systems, Unit 3, Bittern

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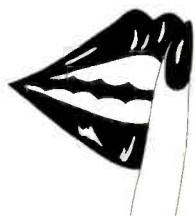
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function by the toggle switch labelled REC MODE. In NORMAL record mode, the AUDIO monitor selectors, select either INPUT or REPRO on to the rear panel XLR (balanced) and jack (unbalanced) audio outputs and on to the front panel headphone jack. INPUT is the audio signal passing from the input sockets, through the ADC and DAC systems. REPRO uses the unique Fostex 4-head replay drum to perform read after write. What happens is that the first of a pair of heads writes the digital data on to the track, then the following head reads it, similar to a conventional off-tape monitor and having an input to output delay of about 185 ms. Placing the machine on RECORD does not affect the monitor source.

Selecting EDIT record mode provides a completely different type of operation. In this mode the pair of heads reverse their function. The first head reads from the tape, then the second head writes over the material just read off. In this mode both INPUT and SYNC/REP indicators light. On entering PLAY, the audio output is taken from the tape but once RECORD is active, the output switches to monitor the input. This is because the machine generates its own internal crossfade between the previous and new versions of the material. During the crossfade, the first head is reading the original material, while the machine input receives the new material. Internally the two sources are mixed in varying proportion until the crossfade is complete approximately 10 ms later. On drop-out, when RECORD is released, the same thing happens in the reverse direction. Of course drop-in might be used live during studio voiceovers or the like, but drop-out would normally only be used when the machine was operated in conjunction with an external editing control system since there is no means of monitoring while recording in that mode. However, running a second machine in sync would allow one to be used as a replay reference while the other was dropping in and out during manual editing.

In practice on both tone and more complex material, edit mode worked beautifully, creating quiet, inaudible crossfades. Fig 1 shows the effect of recording 2 kHz on top of a previously recorded 500 Hz track. The crossfade occurs smoothly while the output level remains constant.

The machine can be put on RECORD in NORMAL mode. In this case there is an abrupt transition from the previously recorded to the new material which produces distinct clicks. The result of this is shown in Fig 2.

Timecode recording, on the other hand, operates

not only in conjunction with the RECORD MODE toggle switch but also with the T/C RECORD MONITOR toggle switch. In NORMAL record mode, the timecode output operates just like the audio monitor output, following the INPUT and SYNC/REP selection directly. In EDIT record mode, the timecode output during playback follows the INPUT and SYNC/REP selectors but when recording timecode, it follows either INPUT or REPRO as selected on the T/C RECORD MONITOR toggle switch. Thus the timecode monitor can either remain fixed at the input, remain fixed on replay, or switch in either direction automatically when dropping into record. This allows the unique possibility of recording exactly the timecode you had previously played back – in sync with itself, allowing timecode to be refreshed, complete with amended user bits. More to the point, with some extra external hardware, the same could be done to other data in the subcode area.

Please note, the EDIT position of REC MODE has nothing whatever to do with the memory location edit function described below, it only affects the audio and timecode recording, replay and crossfade functions.

## Other functions

The remaining pushbutton controls located to the right of the tape transport are multifunction. Some of them proved easy to use while others were not so obvious. In practice, users could expect to get used to the functions they most commonly used.

## Varispeed operation

Pushing the VARISPEED button changes the transport speed from the calibrated standard speed to the last used varispeed setting, ie the machine remembers the last varispeed that was used. Once in VARISPEED mode, the adjacent LED illuminates and speed is adjusted using the UP and DOWN buttons located immediately left. On the initial software version this gave an adjustment of  $\pm 12\%$ , which was shown automatically in the display window in exactly that form. The upgrade software installed to enable synchronised operation, instead offered  $\pm 10\%$  displayed in tenths of a percent. In practice, varispeed is

unobtrusive in operation, silently gliding in pitch as the buttons are pressed. Likewise, switching in and out of varispeed operation glides on to and away from the standard speed.

## Modes

**Cue:** When running at the 5 $\times$  wind speed, the off tape signal can be auditioned by entering CUE mode. This is done by pressing SHIFT at which point the shift LED lights, then CUE. The cue LED will remain lit, and each time a 5 $\times$  FFWD or REWIND is pressed, a distorted but useful playback off-tape will be heard.

**Hold:** The same button used for cue can be used to mark a memory location point, even if CUE is active. Pressing this button once when SHIFT is not active will store the instantaneous tape position into the memory and display that location. The edit LED also lights. When the edit LED is lit, the UP and DOWN buttons will adjust the memorised tape position pointer. The display flashes to indicate whether hours, minutes or seconds can be adjusted. These are cycled through with further presses of the HOLD button, enabling the memory location to be edited to the nearest second. This location can then be transferred to the LOC memories as described below.

**Repeat:** The transport can automatically repeat between the LOC1 and LOC2 memory positions. This is started by activating REPEAT, which must be done in SHIFT mode.

**Blank search:** A blank in DAT terms is not background noise but the recording of a sequence of digital zeros. It represents an area of tape not used before at all. BLANK SEARCH allows these sections of the tape to be found quickly and works only in the SHIFT mode. It might be used to locate the next recording point after doing some over-recording or playing back a section of tape.

**Zero Point Locate (Z.LOC):** Used with both shift and edit LEDs off, this winds the tape in the required direction back to the zero time position. Time on this DAT machine is absolute and is recorded on the tape in the subcode area independently of SMPTE timecode. Pressing PLAY while a wind is taking place causes the machine to enter PLAY on finding the zero point.

In EDIT mode, pressing Z.LOC will offset the zero memory position to the currently held MEMORY EDIT location. The time recorded on the tape is not altered. LOC1, LOC2 and P.LOC are adjusted to maintain their correct physical tape positions. In SHIFT mode, Z.LOC will display the time back to the tape start time, ie the offset between tape top and Z.LOC.

**LOC1 and LOC2:** Pressing either of these when SHIFT and EDIT are not active, winds the tape to the stored location and either stops, or enters PLAY if play is pressed meanwhile. In EDIT mode, pressing LOC1 or LOC2 transfers the stored MEMORY EDIT location to the selected LOC memory. In SHIFT mode, the offset between the LOC position and Z.LOC is displayed.

**P.LOC (Play Locate):** Each time PLAY is pressed, the location is automatically stored in the P.LOC memory. Pressing P.LOC when the EDIT and SHIFT LEDs are off winds the transport back to that location. In the other two modes P.LOC behaves just like LOC1 or 2.

FIG.1 EDIT MODE DROP-IN OF 2KHz ONTO 500Hz PREVIOUSLY RECORDED MATERIAL. NOTE DIGITALLY SYNTHESIZED CROSSFADE

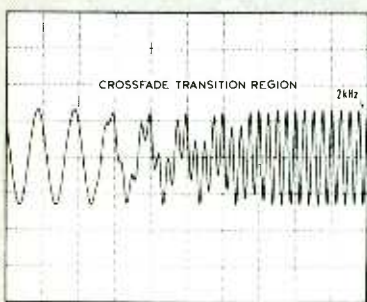
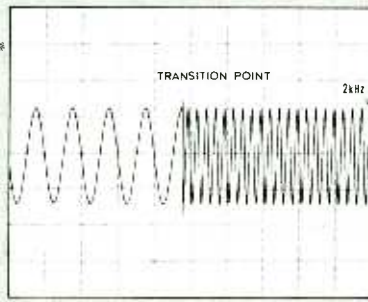


FIG.2 NORMAL MODE DROP-IN AS FIG.1 IN THIS MODE THE TRANSITION IS ABRUPT, CREATING AN AUDIBLE GLITCH





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## Other indicators and switches

The majority of the remaining indicators and switches are self-explanatory. The indicators provide useful feedback on potential problems of dew on the drum, word clock errors, data errors, timecode level and sampling frequency. Switches allow emphasis and copy guard to be switched on or off, selection of analogue or digital inputs, sampling frequency to 44.1 or 48 kHz, internal or external clock, normal or edit record mode (described below), and input level cal or uncal. UNCAL input level switches the CHAN1 and CHAN 2 input level rotary controls into circuit.

## Input and output performance

Fig 3 shows input common mode rejection, which varies from better than 70 dB at 50 Hz to about 40 dB at 3 kHz (channel 2). As can be seen, the two channels differed by about 13 dB throughout their range. The input impedance measures approximately 20 k $\Omega$ , varying little with record level setting, meeting the specification. The record level controls appear to be directly connected to the inputs in the UNCAL mode, since it was impossible to overload the inputs.

The RECORD LEVEL control had a sensible law, setting peak clipping level to +10 dBu at position 10, increasing to +28 dBu at position 5 (centre). Perhaps a little more gain at maximum would be useful. The BALANCE control provides only a small adjustment from 0 to -2 dB, it is not a pan control. Fig 4 shows the level pot tracking error, which is typically 0.5 dB from an attenuation level of 7 dB downward, reaching a maximum of about 0.9 dB, an acceptable performance.

There are three sets of outputs on the machine, all varying slightly in their performance. The XLR balanced outputs provided a measured output impedance of about 45  $\Omega$ , adequately low. Maximum output level was +22 dBu into loads down to 600  $\Omega$ . The unbalanced monitor jack sockets have an output impedance of about 100  $\Omega$  and operate at a level 6 dB below the main outputs. The phones output was not measured but had ample drive to cause me to lift my 150  $\Omega$  headphones from my head in a hurry.

## Noise

As Table 1 shows, noise performance is good, giving an RMS dynamic range over 22 Hz to 22 kHz of about 91 dB without emphasis, rising to over 93 dB with emphasis on. These are the best results for any DAT machine to date. The infinity zero performance indicates that the machine may be muting the DAC outputs when no signal is present. The  $\frac{1}{2}$ -octave swept noise measurement on channel 1 is most boring, revealing almost pure white noise. Both channels were almost identical, though a bump in the noise output was visible on channel 2 at 1.2 kHz which was only present when the transport was running. This is shown in Fig 5.

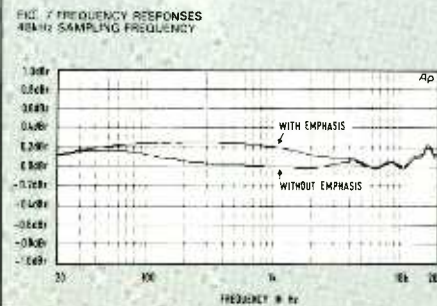
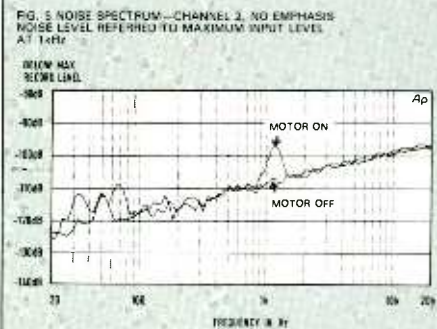
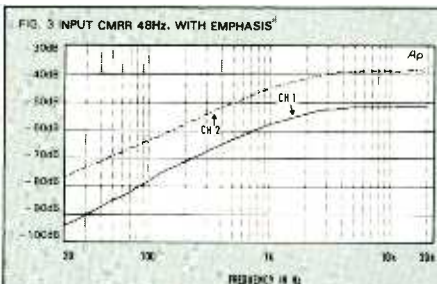
In Fig 6 the modulation noise on channel 1 is

shown with input level at 20 Hz varying from -100 to -40 dB referred to maximum recording level. It can be seen that this averages about 2 dB, the difference between maximum and minimum curves, again the best performance yet. Channel 2 was the same, except it showed the 1.2 kHz transport noise once again.

## Frequency response and linearity errors

Fig 7 shows the in-band record to playback frequency response of channel 1. This has a maximum error of  $\pm 0.1$  dB without emphasis, rising to  $\pm 0.15$  dB with emphasis. Channel 2 was similar, once again an excellent performance. In Fig 8, the out-of-band performance of the anti-aliasing filters is shown. Note that it is switched according to the sampling rate.

	Infinity zero track	Emphasis on	Emphasis off
22 Hz to 22 kHz, RMS	99.7	93.3	91
400 Hz to 22 kHz, RMS	97.9	94.7	91.6
CCIR 468-3, Unwtd, Q-peak	93.6	89.3	87.1
CCIR 468-3, Wtd, Q-peak	87.4	83.5	80.4



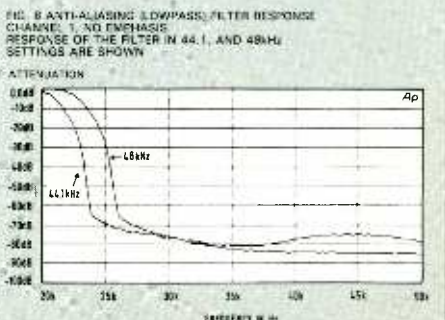
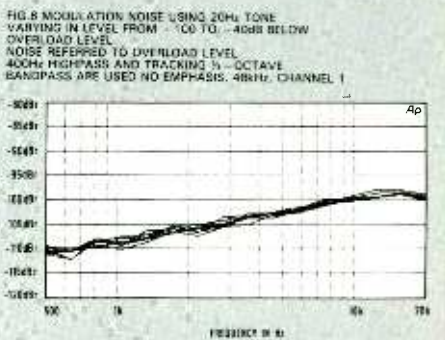
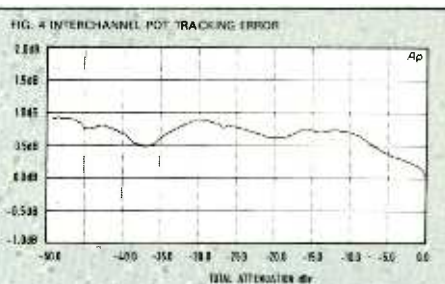
The linearity of the converter systems is also excellent as shown in Fig 9. Note that the linearity is typically within  $\pm 0.5$  dB down to 100 dB below maximum recording level.

Replay only stereo separation between left and right channels is better than 95 dB up to 1 kHz, falling 82 dB at 16 kHz. Fig 10 shows record to replay separation, which is about 10 dB worse but still the best performance of any DAT machine to date, though it does not meet the manufacturer's specifications of more than 80 dB over the whole audio band. Interchannel phase difference is almost unmeasurable. Group delay is a typical 600  $\mu$ s at low and mid frequencies, rising to about 750  $\mu$ s at 20 kHz. No problems here.

## Distortion

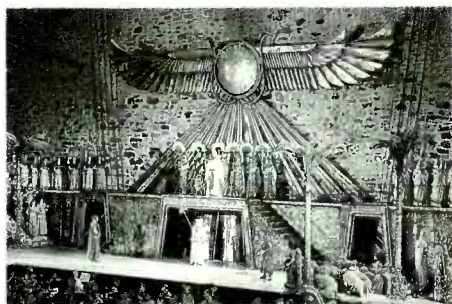
Fig 11 shows the replay only THD+N using a digitally-generated test tape recorded at maximum level. Distortion is below 0.003% up to 1 kHz, then rises to a maximum of 0.04% at 20 kHz. Record to replay THD+N is almost identical, rising more above 10 kHz to a maximum of 0.2% at 20 kHz. This is within specification up to 10 kHz.

Quantisation distortion, shown in Fig 12 reveals that bit weighting errors are small, confirming the excellent performance seen elsewhere.





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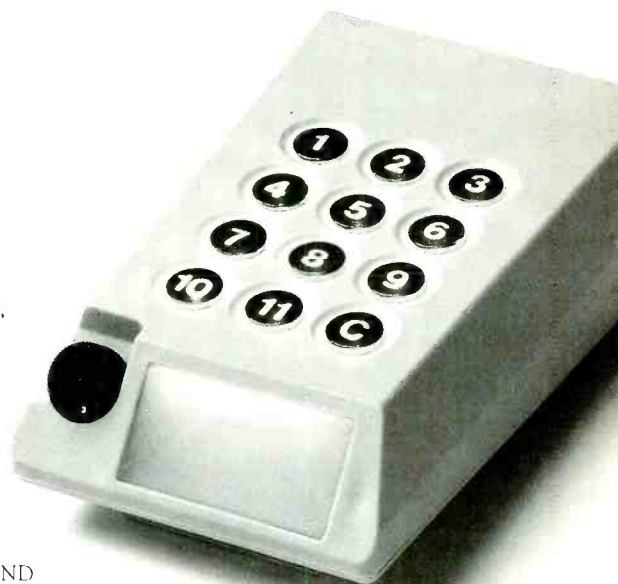
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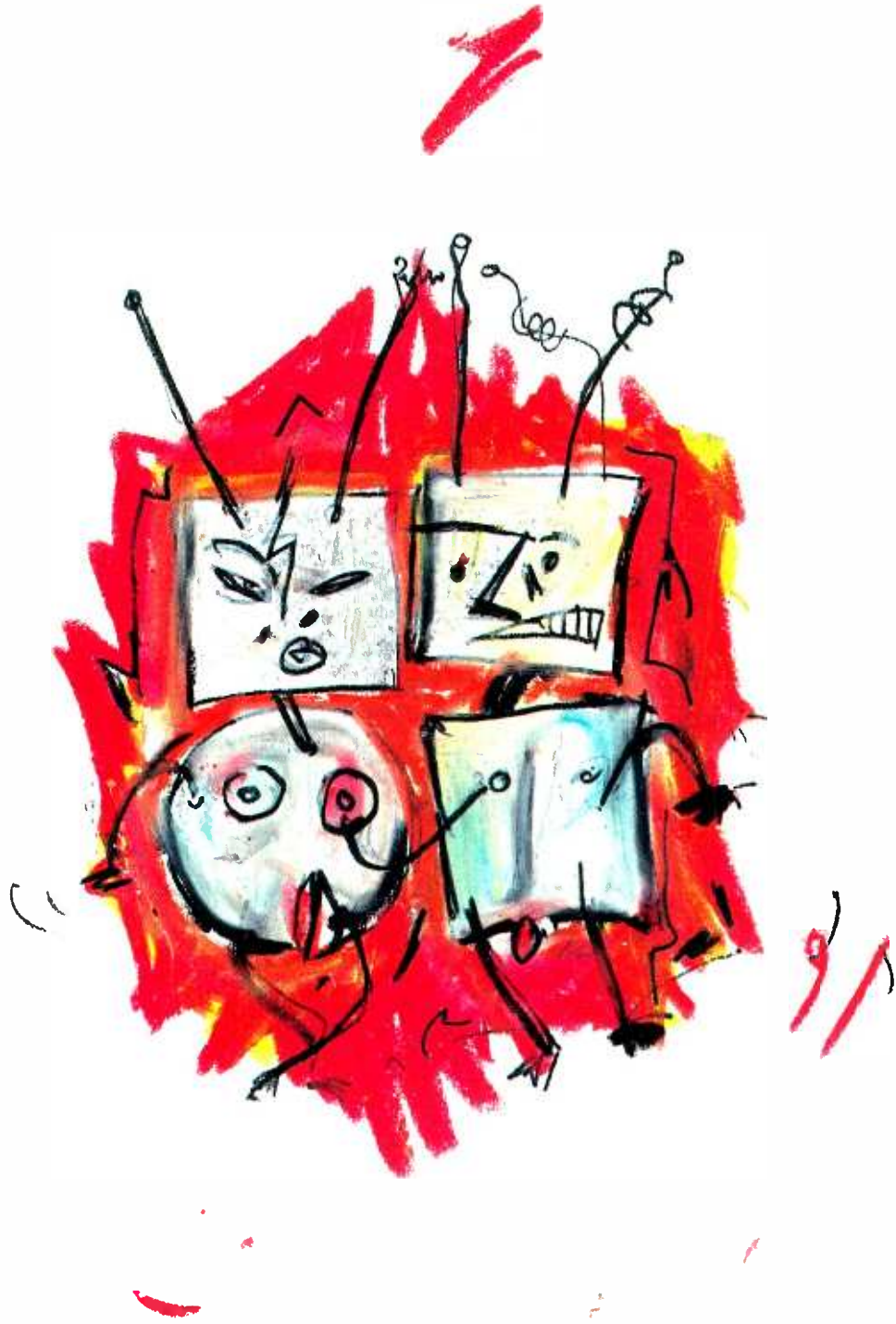
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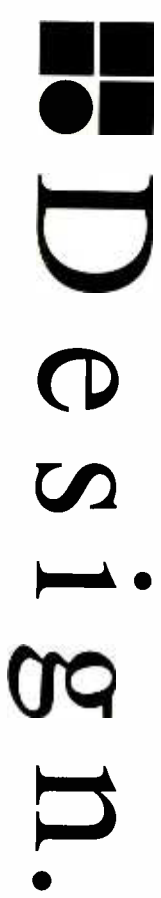
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## Metering

The machine uses meters that appear to be of the fluorescent indicator type. They have a reasonable brightness for the task at hand, neither too bright nor too dim. The meters are accurate down to levels below -40 dB at frequencies up to 1 kHz. At higher frequencies accuracy dropped more rapidly. For example at 5 kHz, errors are obvious for levels below -18 dB. The meter's response time was not measured but it has a much faster attack than a standard PPM, with a quicker fall-back as well.

## Timecode operation

The SMPTE record and replay sockets are balanced XLR-3 types with nominal input and output levels of +4 dBu. The inputs were found to accept input levels from -22 dBu up to at least +18 dBu. The output level is not affected by the input level.

Details of the SMPTE timecode recording technique used is given in the special box below. In short, it is recorded in the subcode area of the DAT track and works without interfering with the Start ID, Stop ID and indexing techniques of standard DAT recorders. Recordings on other machines will replay correctly, and recordings made on the D-20 are compatible with other machines, with the exception of timecode playback. At the moment the D-20 is the only machine with this feature.

On the D-20, timecode works just as on conventional analogue and digital recorders. Code can be pre- or post-stripped on to the tape without affecting either the audio or other subcode data information. Any SMPTE frame rate can be recorded. This same frame rate will be replayed.

Unfortunately, no standard for DAT SMPTE timecode encoding yet exists but the newly proposed IEC standard does not match the way Fostex have currently implemented timecode. Fostex are themselves on the standards committee and are expected to support any finally approved standard. The main difference in the proposal and Fostex's method is that the proposal would allow the recording to be made with SMPTE code at one frame rate and to be replayed at either the same or another frame rate. Richard Wear, of Fostex UK importer, Harman UK says that once a standard is finally agreed any D-20s previously sold would be modified at a nominal charge on the customer's request.

Timecode can be read at full wind rates of 100x play speed and at the scan rate of 5x normal speed.

## Machine synchronisation

Exhaustive tests of synchronisation were not made as part of this review but two D-20s were sync'd using the Fostex 4030 synchroniser/controller. In the lab there were no apparent problems, with the two machines happily chasing each other around the room and locking up nicely. It was almost embarrassing to watch. Sync took

about 2 secs to accomplish. And the machines even remained in lock when the master was varispeeded.

A Fostex standard 20-pin synchroniser connector is provided on the rear panel. This is said to allow control of the D-20 by other manufacturer's synchronisers as well. An RS-422-A serial I/O port is also provided along with two BNC sync inputs. The first BNC allows direct connection of composite video; the second is used for frame or field sync, or word clock, and accepts TTL digital inputs. Selection of the required sync signal is made on a rear panel DIP switch, as is the frame rate for interpreting video sync signals.

## Future direct subcode control

A final 30-pin digital I/O port allows direct communication with the D-20 CPU. This gives access to the error correction circuitry and more importantly to subcode encoding capabilities. This could, for example, be used to turn the D-20 into a CD mastering system complete with the indexing and other CD data functions.

## Summary

The Fostex D-20 seems to be an excellent machine. We did have a temporary problem with the transport at one point, and discovered the ease of disassembling the machine. The fault disappeared without trace in the lab but Harman tell us that it was caused by a bug in the early software release we were using. Some work in cleaning up the low level motor generated noise in channel 2 would be helpful, polishing the edges of a truly excellent performance.

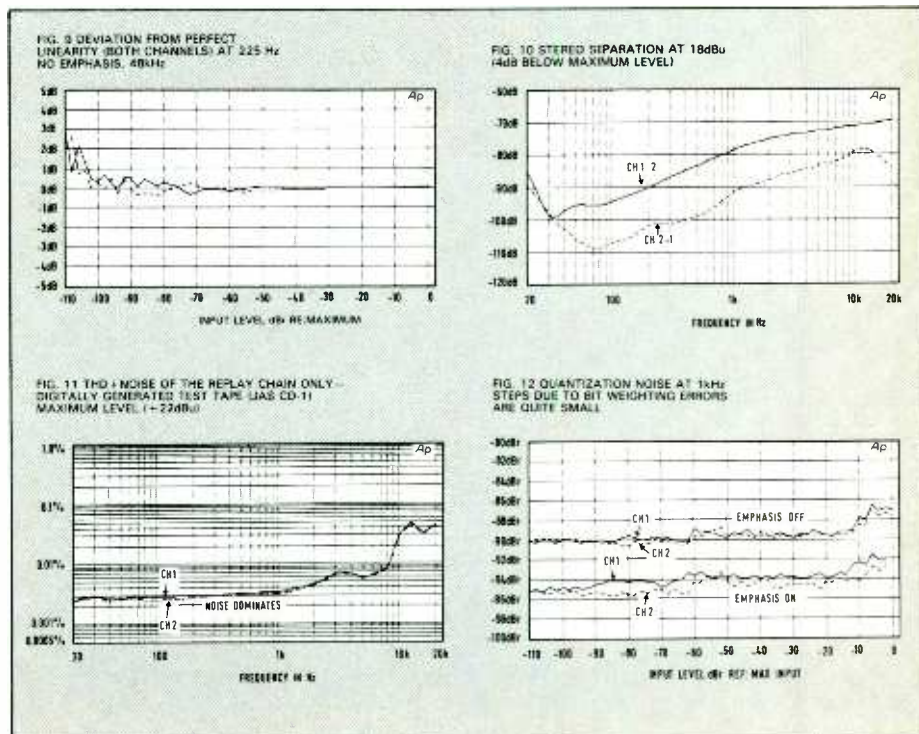
What can you do with it? Well, use it as a

music master recorder for a start. There is a suggestion of sync'd machines replacing banks of 16 mm sel-sync driven film recorders, allowing track slipping to be done at the dubbing desk. This machine is also ideal for use in a 2-machine assemble-editing situation as is used for video editing, and could indeed be sync'd to such machines to improve audio for video quality. It could also be used for re-voicing work, using live recorded tracks on conventional media as a guide. Buy why am I thinking up applications, that's your job, mine is to determine the quality of the product.

As a machine that now has all the facilities of a conventional recorder, except manual cut and splice editing, and a performance equivalent to or better than much more costly reel-to-reel digital machines, it is hard to beat. There only remains the nagging question of DAT tape endurance. Nothing to do with Fostex but still a worry, with reports of mutings occurring regularly after 50 replays of DAT tapes on high quality machines. Perhaps some tape manufacturers would like to come forward with their estimates of tape life. Or maybe we should investigate ourselves. □

## Manufacturer's comment

Since this review was written, Harman have announced that an instability in the digital grounding of the pre-production D-20s (one of which was the machine under review) was detected. This caused a minor digital noise problem on the audio outputs of the machine. Fostex have since rectified this with a small modification applied to those initial machines.



# Details of the Fostex DAT and timecode system

## Heads

Standard DAT machines have a rotary head assembly with two heads on it at opposite sides. Tape wrap around the rotary head is 90°. The Fostex assembly places a total of four heads on the drum set up in two pairs with a spacing of 92.1° between heads. Each pair of heads is located vertically on the drum to allow them to cover the same track stripe on the tape.

According to the application, either of the pair can read the tape (play head) and the other can write to the tape (record head). Thus, read after write or off-tape monitoring can be done if head 1A records and 1B plays back, this is equivalent to a conventional recorder.

If 1A plays off the tape what is there, then 1B records to it, it is possible to digitally crossfade between previously recorded material and new material. The same is true of timecode, except that there is no crossfade, but it is possible to read timecode off the tape, add an offset or other information to it, then record it to exactly the same tape position.

## Timecode

In deciding how to put timecode on DAT, there are two initial options. It might seem logical at

first to put it on one of the analogue auxiliary tracks at the top or bottom edge of the tape but there are several problems here. First the tape edge is most susceptible to damage. Secondly, the DAT tape moves very slowly, only 1/6 the speed of a compact cassette, so getting the high frequencies necessary for SMPTE code on and off the tape is difficult. Third, this high frequency problem gets even worse when one considers the 100x normal speed winding rate of DAT and trying to read timecode at that speed.

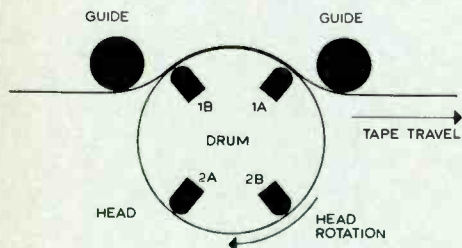
Therefore, it was decided to put the timecode into the digital subcode area of the DAT track. Here another problem occurs. DAT has a frame rate of 33.3 frames/s compared to SMPTE, which ranges from 30 frames/s (NTSC) down to 24 frames/s for motion picture film. Therefore it is not possible to easily match the rate of one to the other. Fostex took the simple decision to just write to the tape the last SMPTE frame available. This means that sometimes there are SMPTE frames missing but that is relatively easy to sort out afterwards if the SMPTE clock information can be maintained. This is accomplished by recording the number of clock

ticks between DAT frames at whatever SMPTE frame rate is used, along with the time error between SMPTE clock edges at the DAT framing times. This allows for perfect regeneration of the SMPTE clock and timecode.

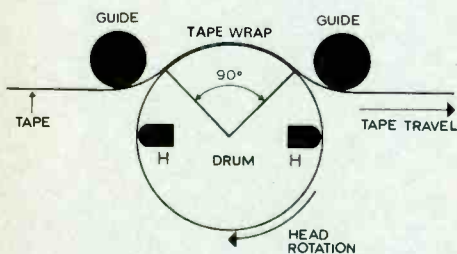
The alternative method of recording timecode on DAT seems to be to use a frame converter, changing the frame rate of the incoming SMPTE timecode to fit the DAT rate, then changing it again on playback. Unfortunately this is more difficult. However, the proposed standard implies some method like this one, since it requires the DAT machine to be able to replay at a different SMPTE rate than was used on record. Time will tell what is actually adopted as a standard. The earliest date for this is a year from now.

## References

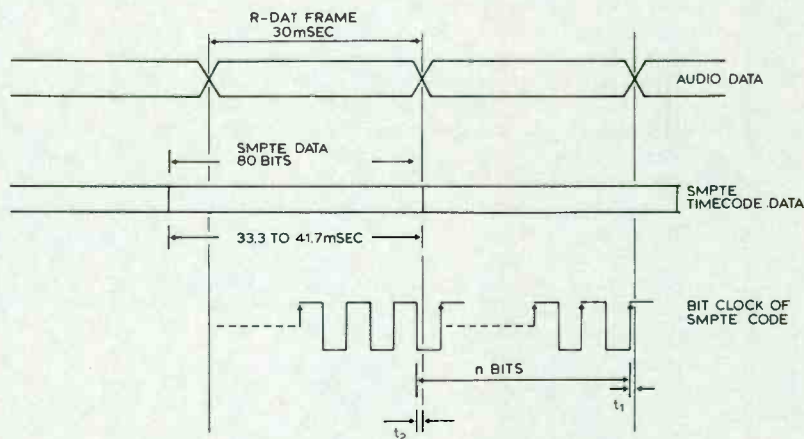
- 1 H Yamazaki, T Ketori, T Morita, S Okazawa, H Nogima and Y Abe, *Timecode in sub data area of R-DAT*, AES Pre-print 2589
- 2 Luc Baert, Luc Theunissen, Guido Vergult, *Digital audio and compact disc technology*, Heinemann Newnes 1988
- 3 Preliminary manual, Fostex D-20



Fostex DAT head assembly



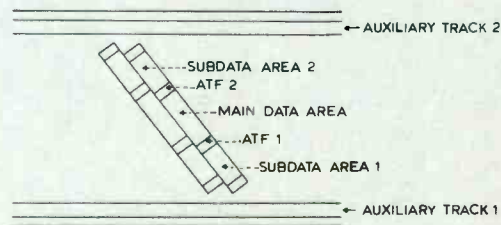
Standard DAT head assembly



Time relationship of SMPTE and DAT digital data



Frame conversion between SMPTE/EBU code and RDAT implied by a proposed standard



Track format of RDAT

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# BSS DPR-502

A user report on a MIDI noise gate from BSS. By Dave Foister

With so much recent outboard gear falling into the multi-effects category it is becoming something of a rarity to see a new product devoted to one specific purpose. Those that choose to follow this path generally have to have something slightly special about them in order to compete and avoid inspiring a feeling of déjà vu in the potential user. This is particularly true when the designers decide to shun fashionable alphanumeric displays, incremental dials, nudge buttons and all the other paraphernalia of digital control in favour of knobs and push switches. BSS Audio's *DPR-502* gate opts for the traditional approach in both areas.

In layout and operation the *DPR-502* could hardly be more familiar. In most respects it is a conventional 2-channel noise gate, providing frequency-conscious gating, comprehensive envelope control, stereo linking, ducking, external keying, side chain access and the familiar 5-pin DIN sockets, but has a few additions and variations to set it apart from the crowd.

The familiar bits all perform to a high standard. BSS's choice of a control panel featuring lots of knobs is a deliberate one. They clearly feel (and I am inclined to agree) that for all the cleverness of digital control systems, you can't beat the intuitive feel and speed of a good old-fashioned control knob. So many devices, including gates, rely for their set-up on the interaction of several parameters, and the laborious process of calling each parameter to be edited in turn, can never match the directness of adjusting a group of real, constantly-active knobs.

The parameters, in this case, include the usual time controls for attack, hold and release, plus threshold and range, all of which provide a useful control range coupled with a sensibly-chosen control law making adjustment easy. Fastest attack time is 20  $\mu$ s, which sounds less impressive than some manufacturers' specs although BSS point out that it is a true attack time to fully open state, so comparison with other manufacturers' figures may be misleading. Many manufacturers calibrate time values in terms of time per so many dB of gain change—like a slew rate—which isn't the same thing at all, but I wonder how many users read specifications in sufficient depth to notice this?

Other familiar controls include bypass switches; on the *502* these are big, red and illuminated—you can't miss them. It seems strange to me, however, that they are so close to the mains on/off switch, whose accidental operation could be disastrous. I am always puzzled why equipment like this has to have a mains switch at all. How many engineers go round switching each individual piece of gear on at the start of a session? If some obscure regulations make them obligatory (and if this is the case why does so much gear not have them?) then they should at least be tucked safely away from the device's main controls.

The first obvious deviation from the norm on the *502* is the method of controlling the side chain to achieve frequency-conscious gating. Most gates use a pair of high- and low-pass filters to remove unwanted frequencies either side of a window containing the wanted signal. This is fine in most cases but still gives a critical set-up on many signals. The *502* on the other hand uses a parametric equaliser-style bandpass filter, whose centre frequency can be varied between 30 Hz and 15 kHz and whose bandwidth is adjustable from 10 octaves down to half an octave. Obviously when this is set as wide as 10 octaves it effectively isn't doing anything. For this reason no in/out switch is provided—the filter is always active in the side chain which means its setting should always be checked when resetting the gate for a new use. I found this approach easier to use (particularly on difficult signals), than the more familiar one. It seems much simpler to home in on a particular useful frequency area than to find the wanted bit by a process of elimination.

A non-latching check switch is provided for monitoring the effect of the filter and, unusually, an internal user option allows this check signal to be brought out separately from the main output so that it can be monitored while the gate is 'live'. Unsurprisingly this filter arrangement removes so much from the input signal at extreme settings that it interacts with the threshold control, requiring the use of a lower threshold as the bandwidth is reduced. However, this is usually the case with a frequency-conscious gate and presents no problems—indeed the intended result is usually a less critical threshold setting anyway.

Setting the threshold and following the gate

action is greatly simplified on the *DPR-502* by the imaginative and informative metering display. On each channel, a row of LEDs displays a 'window' of levels either side of the selected threshold (red above, green below). A bar of LEDs with vu-type ballistics shows the continuous signal level (relative to the threshold) while a peak LED holds the transients on the display for a short time. In addition, a red triangle points at the threshold setting and lights while the gate is open. All of this is considerably more useful than the usual threshold light; it shows how far below the threshold the unwanted signal is and exactly how far above it the wanted peaks are, greatly simplifying the set-up on most signals, particularly drums. It is also useful when setting up the MIDI response, but more of that anon.

Envelope control is made more comprehensive and potentially creative by the inclusion of a very effective Auto Attack mode, which claims to optimise the attack time to react as fast as possible without distortion, and what BSS call the Auto Dynamic Enhancement (ADE) facility. BSS claim this is unique, although the Drawmer *M500*, for one, incorporates something very similar. In order to overcome the apparent loss of transient punch which a deliberate gain overshoot when the gate opens, so that initial peaks are enhanced before the gate-open gain reverts to unity. The size of this peak can be pre-set to either 3 to 4 dB or 6 to 7 dB. The switch for selecting this is located on the rear panel while the in/out switch for the function is on the front. This certainly works very well and, particularly at its more extreme setting, can be used as an effect in its own right, exaggerating bass drum click and snare crack.

The MIDI facilities take the now familiar MIDI gate functions (funny how recently they were innovative and exciting) and expand them a little. As one would expect, each channel sends a Note On command every time it opens and a Note Off when it closes. The velocity byte of the command can be either fixed at 64 or variable between 10 and 127 according to the audio signal amplitude. The *502*'s metering comes in particularly useful for setting up the dynamic tracking, since the velocity value depends on the amount by which the signal exceeds the set threshold.

The obvious use for this is to replace recorded or live drums with samples or MIDI drum machine sounds, or to add further sounds triggered from the real drums. The ability to see clearly the relationship between audio level and MIDI velocity makes it easier than ever to preserve the feel of the original drummer in the context of the new sounds. The only problem I encountered is perhaps inevitable in this situation, and involves the conflicting time value requirements for actual audio gating and MIDI triggering. A sensibly set gate on, eg a snare, will stay open long enough to



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preserve the full sound of the drum; during a fast roll it will probably just stay open. This, of course, means that the connected sampler will not retrigger, and all snare beats after the first are lost. It is very easy to adjust the timing of the gate so that fast, accurate retriggers will happen, but in the process the original sound is wrecked. The answer is to use two gates although a less extravagant way round it should be possible and would surely be appreciated. This is not to denigrate the *DPR-502*, which is particularly effective and easy to use in this role.

The other main MIDI function is the ability to receive note commands; the gates will open and close in response to certain note-on and note-off

values. These numbers are the same as the transmitted note numbers, and like the MIDI channel itself are set on Dip switches on the rear panel. This is obviously inconvenient, but an EPROM update will make all this programmable via System Exclusive messages from a remote computer. This will also expand the control possibilities<sup>1</sup>, so that for instance each gate channel may be mapped to different note ranges on the keyboard. As it stands each channel may be set to respond to a specific note or all notes.

In the meantime it is generally going to be easier when using the *502* as a MIDI trigger to remap the note assignments on the destination sound source. This can be tricky on some drum

machines, where the assignment can only be made by sending the required number to the machine, but another useful feature on the *502* simplifies this. The Check button forces the gate through its open-close cycle regardless of the presence or absence of an audio signal, and causes the relevant MIDI data to be transmitted at the appropriate times. This is also a useful check on many functions; since the VCA is forced open it allows signal checks without bypassing the unit, it allows the attack, hold and release times to be audibly monitored, and checks the action and ballistics of the meter LEDs. Another checking function is a MIDI Active indicator, which lights when any MIDI data is transmitted or received.

An unexpected bonus in the MIDI facilities is an intelligent Merge function, which merges received data with data generated by the *502* itself and re-transmits both via the MIDI OUT socket. For this to be operational, the unit has to be selected (again on the back panel) to Relay mode. It is also possible to select whether or not the gate will re-transmit, or echo, its own internally-generated MIDI commands when it has been triggered by a remote MIDI device.

In addition to all the MIDI selector switches, the ADE level preset switch and the MIDI sockets, the rear panel incorporates all the audio connections. The Key input and side chain access share a 3-pole ¼ inch jack, while ins and outs (capable of handling up to +20 dBV) are on XLRs. The XLR wiring is configured pin 3 hot, which would not necessarily be a problem except for the fact that the output is unbalanced<sup>2</sup>; patching it into my unbalanced insert points using conventional pin 2 hot leads naturally resulted in no signal whatever. This would of course be no problem in a competently wired permanent installation, but hire companies beware!

The overriding impression of the *DPR-502* is of a very user-oriented treatment of a familiar theme. Rather than trying to add hosts of new features, it seems to have set out to make established ideas easier to control, at the same time adding a few specialities of its own. In this it succeeds very well, to the extent that its use is intuitive and hardly requires a manual even when confronted with it for the first time. Noise gates can be notoriously difficult to set up accurately; the *502*'s features, particularly the metering and filtering arrangements, make it one of the easiest and fastest gates I have used. □  
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## Manufacturer's comment

- 1 When this unit was reviewed the System Exclusive access was in the planning stage and is now a reality. Also, a connector to allow these MIDI Dip switches to be removed, ie to the back of an effects rack, has since been added.
- 2 Electronic balanced outputs have been incorporated as standard in the updated version available since November.



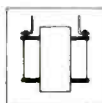


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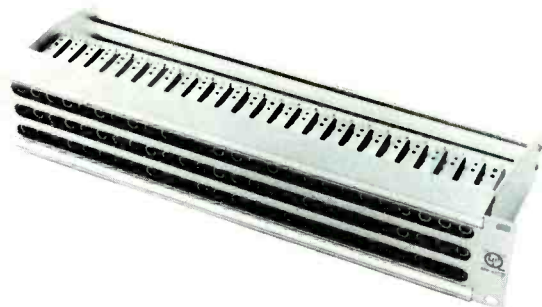
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**APRS EXHIBITION : 7-9 JUNE STAND NUMBER : D23**

# Soundcraft 3200

## An operational report on a new mixing console by David Mellor

Soundcraft enjoy an excellent reputation for producing workmanlike consoles in the mid price range, in the sense that the technical specifications approach the limits of possibility perhaps as closely as consoles by premium price manufacturers. The image of the Soundcraft console, however, has always tended towards the purely functional. Of course, any engineer will give greater regard to substance rather than style. But it is not always technical excellence that sells studio time. A&R departments and producers may be inspired to greater achievement by a console that really looks the part.

The new Soundcraft 3200 is intended to be the company's flagship console, and it is meant to look as good as it sounds. Not only to be attractive to the non-technical user, but also to present its functions clearly and logically to the engineer's eye. To this end, industrial design company Roberts Weaver was engaged to work with Soundcraft's designers to produce a console that looks right as well as sounds right.

The 3200 certainly does look right. Soundcraft's Technical Director Graham Blyth has nicknamed it 'Bigfoot': the large feet, as well as planting the console securely on the ground, also serve as cableways. A door at the rear of each foot allows access for wiring. The other most noticeable feature of the design is that it looks extremely wide, even though it isn't any wider than any comparable console. The proportions have obviously been calculated carefully to give optimum user appeal.

Another, more important, function of an industrial designer is advising on appropriate materials and methods of construction. The strength of this console relies mainly on pressed steel, rather than aluminium extrusions. This apparently cuts the cost of construction with no loss of rigidity. The separate fader section is a departure from normal Soundcraft practice. Up until now, their consoles have had the faders mounted directly on the channel strip. The 3200's separately mounted faders allow for any automation system to be added, either at the time of placing the order or at a later date.

It is a 36-channel, 32-bus split console in the 'traditional' British fashion. After the recent trend towards in-line consoles, Soundcraft believe that a return in taste towards separate monitor sections is imminent. The monitor section, as will be explained, is extremely well specified. Whereas an in-line console has to share the facilities of each channel between the input and the monitor signal paths, the 3200 gives full control over both, avoiding the necessity to choose which path to assign the EQ (or filters, gate or aux sends) to.

For users who require only 24 outputs (rather than the full 32) a 32 into 24 frame size of the console is available. This still has the full 32 buses but the eight 'spares' can be used as additional auxiliary buses. On either frame size more inputs can be specified, traded for fewer outputs.

### Input module

The input module is very clearly laid out. Legending is particularly comprehensive, yet easy to read. Where dual concentric controls are used, the inner knob has a blue legend, the outer knob being marked in white. All controls which need to be easily rotated to their centre position have a detent, otherwise the action is smooth—much better than the continuously variable pots with meaningless clicks used on some consoles. The knobs have clear indicators all the way down to the panel, reducing the effects of parallax.

The top of the module starts with 32 routing switches. Each has an integral LED indicator, as in fact has every switch on the console. Soundcraft claim a very low crosstalk figure for their routing matrix. Obviously, the close proximity of the switches in a typical routing

matrix provides an easy path for capacitive coupling. Attention has been paid to the physical layout of the switches, to the extent, they say, of designing the buttons of the switches to allow components to be placed where the constraints of minimal crosstalk, rather than convenience, demand.

The buses all work in balanced mode. This has the effect of reducing mix noise by very nearly the full 3 dB theoretically possible, and also reduces any interference and crosstalk that the buses—which of course run the whole length of the console—might pick up.

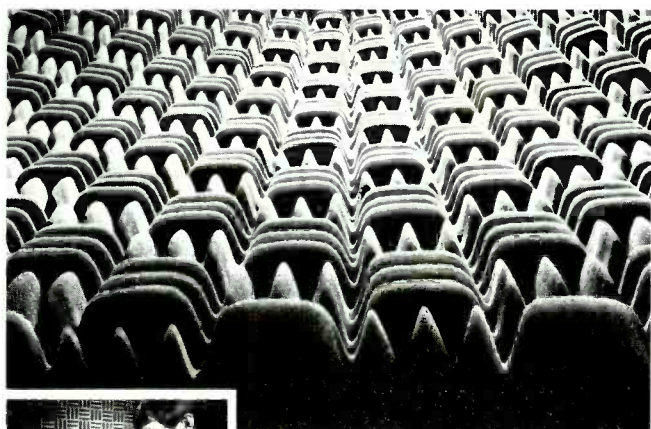
The channel has three electronically balanced inputs, switchable between mic and two lines. There are separate concentric gain controls for mic (padless, 0 to 70 dB) and line (-10 to +20 dB). There is a phase reverse switch and switchable phantom power for the mic input. Following the input stage is a filter section with 12 dB/octave roll off at high (1 kHz to 25 kHz) and low (20 Hz to 320 Hz) frequencies.

A first for Soundcraft is a noise gate on each channel. It has the usual noise gate controls of threshold, depth, attack and decay on two dual concentric pots. The key can be either the signal itself passing through the channel, or an external key can be patched through line input B. In either case, side chain filtering can be performed by switching in the high- and lowpass filters from the section above. Stereo linking is not available, although this could be simulated by paralleling a key signal into the B line inputs. An LED indicates when the gate is muting.

EQ is 4-band sweep. HF and LF (LF peaking or shelving) have frequency and boost/cut dual concentric rotary controls. The two mid sections also have a Q control each, variable from 0.7 to 3. These are of conventional, rather than constant-Q, design. The channel insert point is controlled from



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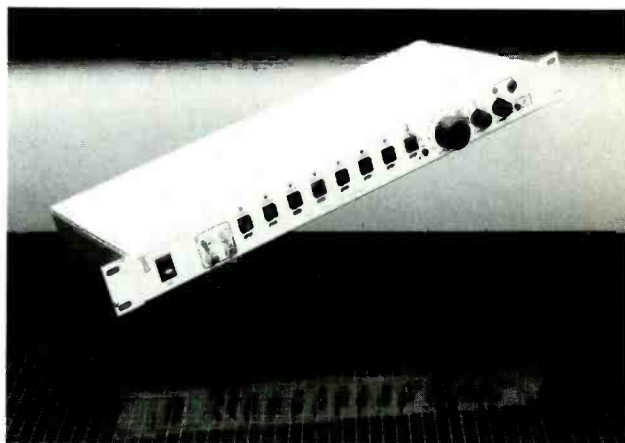
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the EQ section. It can be switched in or out, saving a long cable run to a normal jack in the patchbay when not in use. The insert point can also, usefully, be positioned either before or after the EQ.

The auxiliary send section is very interesting, more so than your average auxes. There is a total of 10 auxiliary controls feeding a possible maximum of 20 aux buses. Soundcraft have opted not to have local pre/post aux switching. The argument is that the on/off switches on each send, and the clear areas of panel space that surround them, are more important. There is, however, an aux master module which controls overall pre/post switching of each auxiliary.

Auxes ST-A and ST-B are stereo sends with concentric level and pan controls. Auxes 1 to 4 are conventional, apart from the master pre/post switching mono sends. For engineers who find that they cannot do without local pre/post switching, auxes 5 and 6 have a REV button which flips the status of the aux to the reverse of that selected on the aux master module. Auxes 7 and 8 are conventional sends feeding aux buses 7 and 8. They can alternatively be routed to any of buses 25 to 32. This clever feature not only makes use of the otherwise redundant high-numbered buses on the 24-output version of the console (which it would probably cost Soundcraft more to omit), it also increases the total number of available aux buses to 20. It should be enough for most purposes! The gain arrangement of the aux controls, by the way, is 0 dB at their maximum position with an extra 5 dB available on the aux masters.

The PAN control is a Soundcraft special. It uses a clever electronic circuit known as a Negative Impedance Converter (NIC) not only to modify the pot law to the optimum sine/cosine characteristic, but also to increase the maximum attenuation available to better than -90 dB. Maximum attenuation of a conventional panpot is limited by the end resistance of the pot itself, which is usually somewhat higher than the ideal 0 Ω.

The Channel On button may be configured as just that, or as a Channel Mute, which some engineers prefer (the power-up mute status, on or off, can also be configured). Either way, there are 4 mute buses controlled from a master switching module positioned in the fader section. Solo can be PFL, AFL or in-place, as selected on the CRM/STU/Phones module, or individually switchable to Safe.

There is an LED overload detector with multipoint sampling, indicating levels coming within 4 dB of channel clipping. The fader is on a 100 mm separate module, which can be specified as ALPs or Penny and Giles.

## Output module

A lengthy description of the output module—or output/monitor module—is unnecessary since it is very nearly identical to the input module. Soundcraft were early players in the game of putting EQ on the monitors, and now they have carried the concept to its ultimate extreme. The filters, gating, EQ and aux sections of the output module are exactly the same as the input module. This leads to several very useful advantages: each

output module can be used as a line input on mixdown; on mixdown, every input has identical features making the console easier to operate. It's powerful stuff.

There are some differences. There is no mic input, but two line inputs are still available. There is no multitrack routing section. A MONITOR PAN control pans the signal to the main mix bus. Alternatively, it can be switched to pan the signal between the group output below and the adjacent group output. GROUP PAN routes the post-fader group output to the main mix output when the MIX button is pressed.

The 100 mm monitor fader controls the level of the monitor signal and can be swapped with the main group fader. The Monitor has similar solo functions and mute grouping functions to the input module.

The TAPE button selects whether the monitor is passing the signal from the multitrack, or from the monitor line input A or B. RECORD READY allows remote multitrack status switching.

Metering may be specified from a choice of vus, PPMs or bargraphs.

## Other modules

The aux master module contains the oscillator: 16 switched frequencies with routing to the patchbay, 2-track, multitrack or aux. It also has a screwdriver-operated level calibration.

The aux masters have level, on, pre and AFL switches. Interestingly, when Soundcraft have reduced the scope for individual pre/post switching on the channel auxes, they have also chosen to pair up the pre/post switching on auxes 1 and 2, 3 and 4, 5 and 6, and 7 and 8. Where the flexibility of the auxes has been increased by having a large number of them, it has been reduced by compromising the switching. Shifting the pre/post switching to a master module seems to be a good compromise—having the switching arranged in pairs less so.

The effects/comms module has 4 stereo effects returns, each with HF and LF filters, an aux send to the ST-A or ST-B buses, rotary fader, on and PFL switches.

An external studio mic input allows the engineer to eavesdrop on studio conversation through the listen-to-control room button, or to

record a floor count in the studio directly to the multitrack.

Talkback routing is comprehensive, to a total of 12 destinations selected by conveniently large buttons.

The CRM/STU/Phones module (could we have an acronym for this please?) has four sets of mixed headphones outputs. Sources for these are ST-A and ST-B auxes, and Studio (the source that has been selected for studio monitoring).

Studio and control monitoring are separately selectable from eight stereo sources. Solo is selected on this module to be PFL, AFL or in-place, with a rotary level trim.

Three sets of control room monitor speakers can be selected. There are mono and dim buttons, the dim ratio being adjustable.

On the 24-input version of the console, there is another module available which includes masters for the extra auxes provided by the eight otherwise-redundant high-numbered buses.

Situated among the faders is a master switching module which selects mic or line for all inputs, group/tape and line A/line B for all output modules, and also has the masters for the four mute buses. All switching is by FET and can be overridden on the individual modules. Soundcraft claim that the master switching is fault-tolerant, and the console can still be operated normally even if the master module is not functioning.

## Conclusion

If production versions of this console live up to the promise of the prototype, and I'm sure that they will, it would be difficult not to come to the conclusion that Soundcraft have excelled themselves. Having facilities on the monitor section as comprehensive as those on the inputs makes such complete sense of the split configuration that in-line consoles seem impossibly complex in comparison. Sensible master switching complements the inherent simplicity of the split console. □

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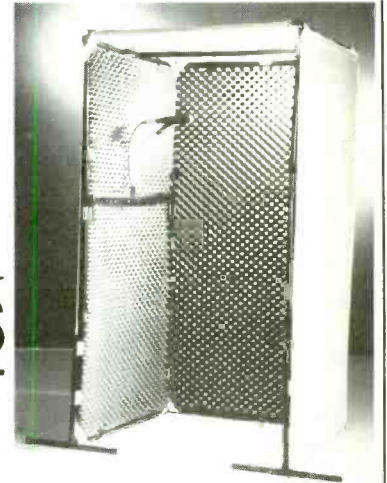
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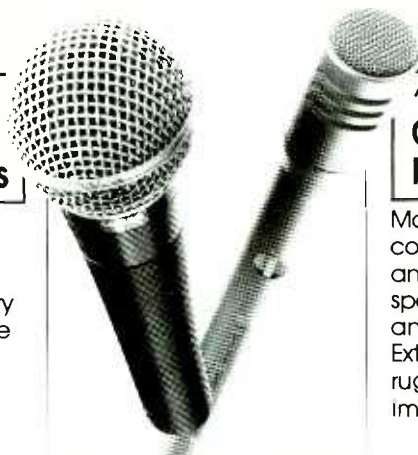
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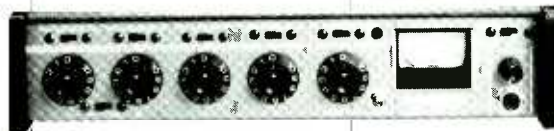
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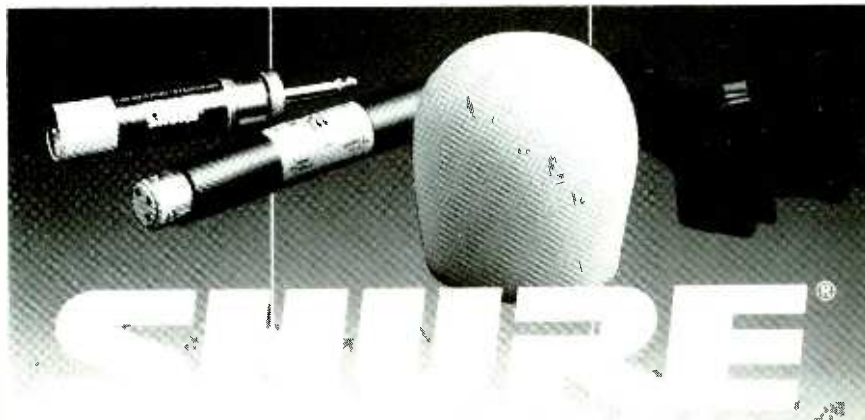
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